3RKH
Reduce, Reuse, Recycle

HEALTHCARE WASTE in asia
INTUITIONS&INSIGHTS

3R KNOWLEDGE HUB

Healthcare Waste in Asia: Intuitions & Insights

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FOREWORD

The risks associated with healthcare waste, and the contemporary management system, have gained attention across the world in various events, local and international forums and summits. The need for proper healthcare waste management is gaining recognition slowly due to the substantial disease burdens associated with poor practices, including exposure to infectious agents and toxic substances. Despite the magnitude of the health problem, capacities and policy approaches in many countries, especially developing nations, in dealing with environmental health problems are inadequate and require intensification.

Realizing the need for safer management measures and eventually reversing the trend of environmental degradation and its negative impact on health, the "Regional Forum on Environment and Health in Southeast and East Asian Countries" was formed in 2007 with attendance of Environment and Health Ministers. Thematic Working Groups were created on six priority areas; one among them is on Solid and Hazardous Waste. The TWGSHW picked up medical waste and municipal waste as the target wastes during 2007/08-2009/10.

3R being a revelation and a striking strategic solution for the waste crisis, the 3R Knowledge Hub shortly, 3RKH was established under the patronage of the Asian Development Bank (ADB) as an adjunct venture sustaining the 3R Initiative which was initiated by the G8 countries and then promoted by many developed and developing countries. The 3RKH is jointly hosted by the Asian Institute of Technology and the United Nations Environment Programme, Regional Resource Centre for Asia and the Pacific in collaboration with United Nations Economic and Social Commission for Asia and the Pacific. The 3RKH functions with specific objectives on expansion of 3R knowledge on Municipal Solid Waste (MSW), Healthcare Waste (HCW) and E-waste and disseminating it to wider audience.

The 3RKH and TWGSHW being on similar platforms of acquiring information on HCW, the assignment of preparing a Healthcare Waste status report was delegated to 3RKH. The study on healthcare waste was consequently, initiated by 3RKH with the support from ADB and TWGSHW and financial aid from Ministry of the Environment, Japan (MOEJ). This report titled "Healthcare Waste in Asia: Intuitions & Insights" presented now is the outcome of the study.

Markedly, this report a milestone product of the 3RKH, under the auspices of ADB and MOEJ, aims to present the prevailing state of healthcare waste in 12 selected countries in the Asian continent. Concisely, the core contents of the report, comprehensively explores the state and facts related to healthcare waste, health hazard, current management system and policy. Apart from meticulously presenting the current situation of healthcare waste, this report places evidence-based recommendations, shares positive and negative experiences from countries of similar economical ground. This report is expected to be a valuable reserve for target groups such as policymakers, technology providers, healthcare facilities, and the public and substantially contributing information for the entire region.

This report is determinedly looked upon as a drive to improve the existing situation and aid in developing appropriate and standardized management system throughout, activate technology and capacity building for enhanced healthcare waste management. We would like to place on records our thanks to all the representatives of the TWGSHW member countries for providing reports and insightful inputs on a timely manner. Without their enduring cooperation this regional report would not have been made possible. We thank and appreciate the 3RKH for their constant efforts in bringing out this report with a regional flavor. We will be failing in our duties, if we do not thank the Ministry of the Environment, Japan for their budgetary support to the TWGSHW.

Hiroki Hashizume
Chair of the Thematic Working Group on Solid and Hazardous Waste
Regional Forum on Environment and Health

PREFACE

The 3R Knowledge Hub, shortly 3RKH, as a complementing effort to the 3R Initiative of the Ministry of the Environment, Japan, was established by the Asian Development Bank, Asian Institute of Technology, UNEP Regional Resource Centre for Asia and the Pacific, and United Nations Economic and Social Commission for Asia and the Pacific. Currently, 3RKH functions with the objective of promoting Reduce, Reuse and Recycle of Municipal Solid Waste (MSW), Healthcare Waste (HCW) and E-waste.

The "Regional Initiative on Environment and Health in Southeast and East Asian Countries" was formed in 2004 and created six Thematic Working Groups (TWGs) of which one is on Solid and Hazardous Waste. The two main areas of focus of Thematic Working Group on Solid and Hazardous Waste (TWGSHW) are MSW and HCW where, at present TWGSHW is focusing on HCW considering it is as one area that receives little attention among policy planners and waste generators alike.

The overlap of HCW between the focal areas of 3RKH and TWGSHW resulted in assigning the task of preparing HCW status report to 3RKH. With the financial support by MOEJ and under the auspices of TWGSHW, 3RKH initiated a study involving the ministries and other organizations related to healthcare waste for collecting the most reliable and authentic information.

This report titled "Healthcare Waste in Asia: Intuitions & Insights" discusses the prevailing situation of waste management in healthcare facilities for 12 countries in the Asian continent, including developed nations Japan and Singapore. The developing countries considered for study are Cambodia, China, Indonesia, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Thailand and Vietnam. This report has been prepared targeting policymakers, technology providers, healthcare facilities, and the public.

More importantly, no report, comprehensively addressing HCW at a regional level, covering 12 countries, especially, is available. This report is highly expected to be a valuable resource for the entire region, which provides evidence-based recommendations, good and bad experiences from other countries of similar economical status. It is ambitiously looked upon of being a good start in providing the impetus to improve the existing condition and aid in planning appropriate and uniform management system, introduce technology and capacity building for better healthcare waste management.

On behalf of our team, I take this opportunity to thank the Ministry of the Environment, Japan for generously supporting this project and providing necessary monetary support and mobilizing information resources. Without their cooperation this study would not have been conceptualized and completed. We would like to extend our deep gratitude to ADB and TWGSHW for their unrelenting support for this project. Our deep gratitude is extended to all the representatives of the TWGSHW member countries for providing their thoughtful insights and critical information for the preparation of this report. We express our gratefulness to UNEP Regional Resource Centre for Asia and the Pacific, for diligently coordinating the data collection with TWGSHW and its member countries. Finally, we wish to express our warm and sincere thanks to all agencies and organizations, who have substantially contributed and individuals who have directly or indirectly contributed in many ways to the development of this report.

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EXECUTIVE SUMMARY

Realizing the threats posed by healthcare waste, the Thematic Working Group on Solid and Hazardous Waste under the Regional Forum on Environment and Health considered it as an important area for action.

The 3RKH and TWGSHW share common interests on healthcare waste as their priority areas. In view of this commonality, 3RKH was tasked with the assignment of preparing a Healthcare Waste status report. The task was initiated by 3RKH with the support from ADB and TWGSHW in turn supported by the Ministry of the Environment, Japan (MOEJ). This report titled "Healthcare Waste in Asia: Intuitions & Insights" is the outcome of the study.

Understanding the liability of the study and its possible reflections on future decisions, information sources were selected with due care. Ministries and organizations related to healthcare waste were considered the key sources of information. The principal source of information was the reports and presentations of TWGSHW country representatives' made during the 1st meeting of the Thematic Working Group on Solid and Hazardous Waste, 28-29 February 2008, Singapore.

The core of the report consists of three Chapters, Country Reports, Global Experiences and Lessons to Learn and finally the Recommendations.

The country reports present an overview of the country following which a profile of the healthcare facilities in the country is provided. The succeeding section of the country report discusses the healthcare waste scenario and management in the facilities. The subsequent section presents current institutional set up and its contribution to the HCWM and the prevailing policies, regulations and legislations. The next section includes multilateral and international organization involvement in HCWM.

The Chapter on Global Experiences and Lessons to Learn begins with snapshots of the healthcare waste scenario in the study countries and then provides an overview of healthcare waste management across the world, from European and other Asian countries as a revelation. Following this, an attempt has been made to throw light on some non-destructive technologies for healthcare waste management. This section has been provided with the idea of bringing to limelight the various non-burn technologies available and clearing the minds, that incineration is the only option for managing and disposing healthcare waste.

Understanding that placing country specific recommendations in a study involving 12 countries is impractical, the recommendations of this report proved versatile healthcare waste management solutions implementable by almost all developing member countries. Based on an overall understanding gained from the study, the report prioritizes policies and legislations for healthcare waste management, budget allocation, and knowledge and technology management as key areas for action.

ACRONYM & ABBREVIATION

ADB	Asian Development Bank
AELB	Atomic Energy Licensing Board
AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine
ARMM	Autonomous Region in Muslim Mindanao
BEMS	Biomedical Engineering Maintenance Services
BHDT	Bureau of Health Devices and Technology
BHFS	Bureau of Health Facilities and Services
BMA	Bangkok Metropolitan Administration
CAR	Cordillera Administration Region
CEO	Chief Executive Officer
CHD	Center for Health Development
CITENCO	Ho Chi Minh City Environmental Company
CLS	Cleaning Services
CWMS	Clinical Waste Management System
DANIDA	Danish International Development Agency
DAO	Department Administrative Order
DDA	Department for Development Affairs
DENR	Department of Environment and Natural Resources
DH	District Hospital
DoC	Department of Construction
DoE	Department of Environment
DoEPP	Department of Environment Phnom Penh
DoH	Department of Health
DoHPP	Department of Hygiene and the Preventive Pathology
DoPPH	Department of Provincial Public Health
DMR	Department of Medical Research
DPCS	Division of Public Cleansing Services
DTPWs	Department of Transport and Public Works
EIA	Environmental Impact Assessment
EMB	Environmental Management Bureau
EMB-CO	Environmental Management Bureau-Central Office
EMB-RO	Environmental Management Bureau-Regional Office

EPBs	European Polar Boards
EPCA	Environmental Pollution Control Act
EPHA	Environmental Public Health Act
FEMS	Facility Engineering Maintenance Services
FGPs	Family Group Practices
GDP	Gross Domestic Product
HCFs	Healthcare Facilities
HCW	Healthcare Waste
HCWM	Healthcare Waste Management
HF	Health Facilities
HMOs	Health Maintenance Organizations
HSMP	Health Sector Master Plan
HWG	Hazardous Waste Generator
HWMS	Healthcare Waste Management System
HWTS	Hazardous Waste Tracking System
IFC	International Finance Corporation
IFHP	Integrated Family Health Post
JAO	Joint Administrative Order
JICA	Japan International Cooperation Agency
JMA	Japan Medical Association
Lao PDR	Lao People's Democratic Republic
LCP	Lung Center of the Philippines
LEPB	Local Environmental Protection Bureaus
LLS	Linen and Laundry Services
MEWR	Ministry of the Environment and Water Resources
MNA	Malaysian Nuclear Agency
MoD	Ministry of Defense
MoE	Ministry of Environment
MoF	Ministry of Finance
MoH	Ministry of Health
MoNRE	Ministry of Natural Resources and Environment
MoPH	Ministry of Public Health
MoST	Ministry of Science and Technology
MoSTE	Ministry of Science, Technology and Environment

MPBND	Ministry of Progress of Border Area Development and National Races and Development Affairs
NCDPC	National Center for Disease Prevention and Control
NCHFD	National Center for Health Facility Development
NCMH	National Center for Mental Health
NCR	National Capital Region
NDRC	National Development and Reform Commission
NEA	National Environment Agency
NEHP	National Environmental Health Program
NEMAP	National Environmental Management Plan
NGOs	Non Government Organizations
NH	National Hospital
NHG	National Healthcare Group
NIP	National Implementation Plan
NKI	National Kidney Institute
NPHSS	National Privatization of Hospital Support Services
NRL	National Reference Laboratory
NSWMC	National Solid Waste Management Commission
PCCDs	Pollution Control and Cleansing Departments
PCD	Pollution Control Department
PCMC	Philippine Children's Medical Center
PDoH	Provincial Department of Health
PH	Provincial Hospital
PHC	Philippine Heart Center
POC	Philippine Orthopedics Center
PPCs	Provincial People's Committee
PPP	Purchasing Power Parity
PPWM	Phnom Penh Waste Management
RIHM	Research Institute of Hospital Management
RITM	Research Institute for Tropical Medicine
ROs	Regional Offices
SARS	Severe Acute Respiratory Syndrome
SEMLA	Strengthening Environmental Management and Land Administration

SEPA	State Environment Protection Administration
TIWR	Toxic Industrial Waste Regulations
TSA	Transporters Service Agreement
TWG	Thematic Working Group
TWGSHW	Thematic Working Group on Solid and Hazardous Waste
URENCO	Urban Environemntal Companies
WB	World Bank
WHO	World Health Organization
WMRAS	Waste Management and Recycling Association of Singapore
WWTP	Wastewater Treatment Plant
YCDC	Yangon City Development Committee

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INTRODUCTION

BACKGROUND

Asia, the largest and most populated continents, has grown more affluent in the last 50 years, faster than any other region of the world. In reality, this growth did not occur at the same pace all over the continent. The western part of Asia grew during this period nearly at the same rate as the rest of the world, but, as a whole, the eastern half consisting of countries such as China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand showed superior performance, with variations in achievements. China, Indonesia, Japan, Malaysia, and Thailand performed well achieving growth rates of 3-5% in the early 1990s (IMF, 1997). This impressive achievement was modest compared to the phenomenal growth of Hong Kong, Korea, Singapore, and Taiwan leaving behind an urge among the other countries to grow on par with them. The current phase of overall growth in most developing Asian countries is the result of their endeavors to establish economic supremacy and stability.

Beyond doubt, the Asian continent is the fastest growing region in the world with economic indicators spiraling upward. Equally increasing are the concerns facing the region stemming from this growth, both in terms of resource availability to meet the demands and capacity to assimilate the discards.

While developing Asian countries are still on the upward part of the economic curve trying hard to meet the basic demands, satisfying the expectations of all citizens has become a mammoth task. Let alone the availability of resources and the issues in making them accessible. For example, an essential component of the attempt to satisfy the expectations of the citizens is the widely-debated waste management issue. Evidently, all activities leave behind some quantities of waste which has to be properly managed. The ill effects of unattended waste have been widely discussed by many stakeholders across the world and needs no elaboration; from rodent threats to polluted groundwater, the issues are multifarious.

While meeting the basic needs of food, shelter and clothing is itself a priority for governments of Asian developing countries, their attention towards environment and health issues is mostly diluted. Recognizing the need to assist developing countries meet their development targets in an environmentally safe and sustainable manner, several collective actions have been instituted.

REGIONAL FORUM ON ENVIRONMENT AND HEALTH

Every year, an estimated 6.6 million deaths in Asia are attributable to various environmental health risks, accounting for one quarter of all deaths in the region. Regardless of the magnitude, the capacity to deal with such problems, in developing countries especially, is limited. Understanding very well that health and environmental issues are largely linked to one another, it is essential to take a coupled approach in helping developing countries address the issue comprehensively. In taking this coupled approach, it is immensely important to bring health and environment agencies for closer coordinated action, if not in all, but in areas where there is greater overlap in their mandates. This has been the grounds for the genesis of the Regional Forum on Environment and Health.

The regional initiative originally started as a high-level meeting in November 2004 at Manila, Philippines, involving the top brass from environment and health agencies of Southeast and East Asian countries. The meeting recommended that a Ministerial Regional Forum be convened. Following this, the second high-level meeting was conducted in December 2005 at Bangkok, Thailand, to discuss a Charter of the Regional Forum, and resulted in a draft charter. The second high-level meeting decided to convene the first Ministerial Regional Forum on Environment and Health in Bangkok, Thailand, where the Charter of the Regional Forum was endorsed, and work plans to address priority environmental health issues agreed. Subsequently, the Regional Forum on Environment and Health for Southeast and East Asia was established at its first meeting held in Bangkok, Thailand in 2007.
The general objective of this regional initiative is to effectively deal with the environmental health problems within countries and among themselves by increasing the capacity of Southeast and East Asian countries on environmental health management.

It aims to strengthen the cooperation of the ministries responsible for environment and health within the countries and across the region by providing a mechanism for sharing knowledge and experiences, improving policy and regulatory frameworks at the national and regional level, and promoting the implementation of integrated environmental health strategies and regulations. Specifically, the Regional Forum on Environment and Health aims at assisting countries to:

- Effectively and efficiently achieve their targets on Health, Environmental Sustainability, Poverty, and Global Partnership for Development under the United Nations Millennium Development Goals.
- Institutionalize the integrated management of environmental health at all levels within each participating country and among the Southeast and East Asian countries, through the setting up of a coordinative institutional mechanism
- Enable countries to assess priority environmental health risks, develop and implement cost-effective National Environmental Health Action Plans (NEHAP), and disseminate the same to the various stakeholders

Matching the objectives of the forum to address the environmental health issues in the countries six thematic working groups (TWGs) were formulated among the interested countries. The TWGs were set on the areas directly threatening most Asian countries:

- Air Quality
- Water Supply, Hygiene and Sanitation
- Solid and Hazardous Waste
- Toxic Chemicals and Hazardous Substances
- Climate and Ecosystem Changes
- Environmental Health Emergencies

Countries of the Regional Forum on Environment and Health

Brunei Darussalam
Cambodia
China
Indonesia
Japan
Korea
Lao PDR
Malaysia
Mongolia
Myanmar
Philippines
Singapore
Thailand
Vietnam

Regional and International Partners

- Asian Institute of Technology, Thailand
- Curtin University, Australia
- International Lake Environment Committee Foundation, Japan
- Overseas Environmental Cooperation Center, Japan
- Pacific Basin Consortium for Environment & Health Sciences, USA
- United Nations Economic and Social Commission for Asia and the Pacific
- United Nations Environment Programme
  - Division of Technology, Industry and Economics
  - International Environmental Technology Centre
- UNEP Regional Office for Asia and Pacific
- UNEP Regional Resource Centre for Asia Pacific
- World Health Organization,
  - South-East Asia Regional Office
  - Western Pacific Regional Office

THEMATIC WORKING GROUP ON SOLID AND HAZARDOUS WASTE

Waste management has always been a compounding issue faced by local and national governments of all Asian countries, regardless of their economic might. Both developed and developing countries are forced to tackle different issue at various stages of waste management. For example, Asian developing countries find difficulty in institutionalizing waste segregation and collection, while the developed ones, for example Singapore, find difficulty in disposing the waste after proper collection owing to limited land. Other issues that threaten these countries arise in the forms of drastic increase in waste volumes, regional difference in waste composition, illegal movement of waste resulting in trans-boundary issues and lack of legal and financial mechanisms for the proper implementation of waste management programs.

Leaving aside the threats, disposal of the waste as such has been an issue and in many developing countries in Asia, open dumping is the most preferred and prevalent method for disposal often leading to environmental problems such as water contamination, air pollution, odour problems, health impacts, and hygiene issues. In addition, heavy metal contamination, increase of hazardous substances in industrial waste, mixing of infectious waste with municipal waste, and environmental burden and health problems derived from inappropriate treatment of e-waste have been significant and emerging issues to be tackled both at the regional and national level in the continent.

Taking into account the multidimensional issues originating from solid and hazardous waste, the Thematic Working Group on Solid and Hazardous Waste (TWGSHW) is assigned to work towards addressing municipal solid waste and medical waste issues. The TWGSHW works in closely with the environment and health ministries of Cambodia, China, Indonesia, Japan, Laos, Malaysia, Mongolia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The TWGSHW functions with the objectives of,

1. Ensuring environmentally sound management of solid and hazardous waste, in particular municipal waste and medical waste, and to promote the 3Rs in Southeast and East Asian countries
2. Prioritizing issues by analyzing status-quo of municipal waste and medical waste management in the member countries
3. Providing useful information to raise policymakers' awareness on the importance of, to increase investment addressing to, and to mobilize bilateral and multilateral assistance for the importance of linkages between waste and health.

Though tasked with broader objectives of ensuring appropriate management of solid and hazardous waste in its member countries, the TWGSHW first focused on the management of healthcare waste (also colloquially known as medical waste and often interchangeably used) owing to its toxicity, hazardous nature and rapidly growing volumes. Often healthcare waste is referred to as the rapidly growing priority waste streams in many countries and is mostly mishandled due to lack of knowledge and awareness on the waste itself. Moreover, when providing reasonable healthcare is itself an issue for many developing Asian country governments, appropriately addressing healthcare waste appears to be too ambitious. However, proper handling of healthcare waste cannot be neglected citing any reason and it is rational to introduce appropriate healthcare waste management while the healthcare system is itself being built.

With this background this reports elucidates the fundamentals of healthcare waste management and discuses the current situation in the member countries of TWGSHW.

HEALTHCARE WASTE

The most authentic definition from the World Health Organization (WHO) characterizes healthcare waste as a kind of waste generated mainly from hospitals, medical centers, healthcare establishments and research facilities in the diagnosis, treatment, immunization and associated research. WHO has divided healthcare waste into nine categories such as infectious waste, pathological waste, sharps, genotoxic waste, chemical waste, pressurized containers, radioactive waste, heavy metals waste and pharmaceutical waste. The definitions for the above waste categories are listed in Table in the next page with some examples.

Healthcare waste arises from a healthcare service system and includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials.

In 2000, WHO estimated that around 23 million people were infected with Hepatitis B, Hepatitis C and HIV worldwide due to injections used with contaminated syringes in healthcare facilities. Similar cases are prone to occur when healthcare waste is dumped in an uncontrolled manner become easily accessible to the public, especially children. Further, in 2002, the results of a WHO assessment carried out in 22 developing countries showed that around 18-64% of the healthcare facilities do not use appropriate disposal methods. Recently, a number of Asian countries have recognized the importance of proper waste management in the last 10 years, especially, in the capital cities to avoid health impacts. However, waste management practices differ between developed and developing countries, urban and rural areas, and residential and industrial areas.

In most of the developing countries infectious, pathological wastes and sharps are incinerated / open burned and the bottom ash is disposed along with the municipal waste while the fly-ash is disposed as hazardous waste. Chemical liquid wastes are collected and treated through the hospital effluent treatment system, and disposed into the municipal sewer. On the other hand, pharmaceutical wastes (including expired medicine) are often left unattended.

Major sources of HCW

Hospitals
- Private hospital
- General hospital
- District hospital

Other healthcare establishments
- Emergency medical care services
- Healthcare centers and dispensaries
- Obstetric & maternity clinics
- Outpatient clinics
- Dialysis centers
- Transfusion centers
- Military medical services

Related laboratories and research centers
- Medical and biomedical laboratories
- Biotechnology laboratories & institutions
- Medical research centers
  - Mortuary and autopsy centers
  - Animal research & hospitals
  - Blood banks and blood collection services
  - Nursing homes for the elderly

Source: WHO, 1999

Commonly used HCW Symbols

Source: WHO, 2008 and SBC, 2004

Classification of Healthcare Waste by WHO

Waste Category	Definition	Example
Infectious Waste	Waste suspected to contain pathogens	Laboratory cultures, waste from isolation wards, tissues (swabs), materials or equipment that have been in contact with infected patients, excreta
Pathological Waste	Human tissues or fluids	Body parts, blood and other body fluids, fetuses
Sharps	Waste containing sharp edges	Needles, infusion sets, scalpels, knives, blades, broken glass
Genotoxic Waste	Waste containing substances which cause damage to DNA	Waste containing cytostatic drugs (often used in cancer therapy), genotoxic chemicals
Hazardous Chemical Waste	Waste containing chemical substances	Laboratory reagents, film developer, disinfectants that are expired or no longer needed, solvents
Pressurized Containers	Containers used to store gases under pressure	Gas cylinders, gas cartridges, aerosol cans
Radioactive Waste	Waste containing radioactive substances	Unused liquids from radiotherapy or laboratory research, contaminated glassware, packages or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclide
Heavy Metal Waste	Waste with high content of heavy metals such as mercury	Batteries, broken thermometers, blood-pressure gauges
Hazardous Pharmaceutical Waste	Waste containing pharmaceuticals	Pharmaceuticals that are expired or no longer needed, items contaminated by or containing pharmaceuticals (bottles, boxes), expired vaccines
Highly Infectious Waste	Waste consists of microbial cultures and stocks of highly infectious agents from Medical Analysis Laboratories and body fluids of patients with highly infectious diseases.	

Source: WHO, 2008b

CONCERNS IN HEALTHCARE WASTE MANAGEMENT

Poor healthcare waste management results in adverse effects on the environment and the public health. The most commonly noted issues in proper healthcare waste management are in terms of safe disposal of infectious and sharp waste, occupation safety for workers handling the waste and illegal scavenging of salvageable materials from the healthcare waste.

Safe disposal

The safe disposal of healthcare waste consists four key stages such as segregation, collection & storage, treatment, transport & safe disposal (WHO, 2008) where national legislation must be followed.

Separation: The four major categories of healthcare waste recommended for organizing segregation and separate storage, collection and disposal are: sharps, whether infectious or not; non-sharps infectious waste; general waste; and hazardous waste.

Collection & Storage: The collection and storage depends on the different types of waste produced in the healthcare facilities. Generally, sharps are collected in yellow puncture-proof containers/bags with cover. Similarly, non-sharp infectious wastes are collected and stored in yellow or red waste bags or containers. These sharps and non-sharps infectious wastes are disposed safely after proper treatment immediately. The general wastes are collected in black containers and disposed daily. Any kind of waste containers are recommended to be placed five meters from the source of waste generation. Hazardous waste should be labeled and stored in an appropriate secure location and radioactive waste should be stored in containers that block radiations.

Treatment: Incineration, disinfection, sterilization, plasma-arc and land filling been adopted for the treatment of healthcare waste. However, treatment techniques differ between wastes. Sharps are disposed in designated pits and non-sharp infectious waste can be buried in a pit fitted with a sealed cover or, incinerated or steam sterilized on-site or off-site. The preferred option for infectious waste is steam sterilization which avoids the air pollution that may arise from incineration. General waste can be buried in a pit, a landfill site or treated as municipal waste or incinerated. Ashes and residues should be buried in a pit. There are several kinds of hazardous waste and each requires specific treatment which includes encapsulation, sterilization, burial, incineration and long-term storage. Pharmaceutical wastes are to be returned to the supplier.

Incineration as a treatment option has its own merits and demerits and recently it has been universally agreed that the demerits outweigh the merits and a global call for the move towards non-burn technologies has been launched. Incineration is observed to change the physical form of the waste accompanied by the emission of harmful air pollutants and toxic ashes requiring separate careful disposal.

Transport & Disposal: Disposal area should be fenced off with facilities for wastewater disposal into a sewerage system and located at least three meters from groundwater sources. The area should be large enough for extension if new pits or other facilities have to be built.

Occupational safety

Among the healthcare wastes, sharps are of major concern to all healthcare staff alike, doctor, nurses, midwifes healthcare workers, recyclers and community at large. Needlestick injuries during disposal and recovery of used sharps are possible and have to be totally prevented.

Points to Ponder for Safe Healthcare Waste Disposal

Design & Construction

- Are there facilities in place for segregating healthcare waste at the point of generation?
- Are there sufficient waste containers of the right sort and design in the right places?
- Are there appropriate treatment and disposal facilities in place for the quantity and nature of healthcare waste produced?
- Is there a specific wastedisposal zone with the necessary features?

Operation & Maintenance

- Are the segregation facilities used effectively?
- Are waste containers emptied, cleaned and replaced or disposed of frequently?
- Are the treatment and disposal facilities correctly operated and maintained?
- Are waste-related injuries along the waste management chain correctly reported and acted on?
- Is the wastedisposal zone operated so as to prevent contamination?

Source: WHO, 2008a

Reuse potential

In most of the developing countries, the sale of used sharps and plastics is profitable. Hence, there is a potential for illegal reuse of used sharps which cause a risk to the entire community.

Unfortunately, the most of the economically developing countries experience a mixture of constraints to manage the healthcare waste satisfactorily. Usually, few individuals of the healthcare facilities are familiar with the procedures required for appropriate waste management. Hence, it is the responsibility of national governments to develop a framework for the controlled disposal of healthcare waste and to ensure that healthcare centers share the responsibility to manage wastes appropriately. This requires a national strategy involving the concerned ministry and other stakeholders. Further, creating national action plans, developing national healthcare waste management guidelines and building capacity at the national level are important activities which can help to minimize risks posed by healthcare waste to the environment and public.

FOCUS OF THE REPORT

In developing Asian countries, the importance and urgency for action on healthcare waste management has not been duly recognized. Healthcare waste is yet another waste stream and has to be advocated for attention among various other pressing issues.

In this context, the primary objective of this report is to present and discuss the current situation of healthcare waste management in the TWGSHW member countries. A parallel objective of the report is to understand both sides of the issue and to bring to limelight the good practices and banish the bad practices.

Finally the report places evidence-based recommendations for the betterment of healthcare waste management, not only in the member countries of the TWGSHW but in a regional context.

2

METHODOLOGY

Quy

ƠNG PHÁP RỬA TAY BẰNG D

Lấy 5 ml dung dịch khử khuẩn

60 g

30

tay vào nhau

Chà lòng bàn tay phải lên mu bàn tay trái và ngược lại, các ngón tay xen kẽ nhau

Chà hai lòng bàn tay vào nhau, các ngón tay xen kẽ nhau

Chà mu
lòng bàn

sạch toàn bộ hai bàn

Lấy khăn sạch

Lau khô bàn tay

GENESIS OF THE REPORT

This section discusses the genesis of the report, "Healthcare Waste in Asia: Intuitions and Insights", arising from the study conducted by 3R Knowledge Hub. This section presents components of the study addressing all aspects of healthcare waste in 12 member countries of the Thematic Working Group on Solid and Hazardous Waste. Table below lists the countries covered in the study.

Member Countries of TWGSHW
Cambodia
China
Indonesia
Japan
Lao PDR
Malaysia
Mongolia
Myanmar
Philippines
Singapore
Thailand
Vietnam

COMPONENTS OF THE STUDY

1. **Country specific information on healthcare facilities**
   Obtaining micro level, specific information such as profile of the healthcare facilities and hospitals, that is classified under different categories, and scale and level of services offered by them.

2. **Healthcare waste generation**
   Obtaining the waste generation rates based on the capacity of the hospitals as well as the overall generation per year in order to project the magnitude of HCW. Obtaining information on the characteristics, and composition of waste such as contribution of sharps, general waste, plastics and infectious waste in total waste generated to assess the adequacy of the present treatment methods and handling system.

3. **Healthcare waste management**
   Collecting information on the type of collection, with the details of segregation practices, use of color-coding containers or bags based on the composition of waste generated, details on storage facilities of waste that has to be disposed out side the facilities till disposal time. Information on the transportation systems used based on system of disposal and treatment adopted in the facilities and region e.g., the centralized and decentralized system for incineration adopted in many countries, type of transportation system. The current treatment and disposal methods of healthcare waste based on the type of waste such as, autoclaving and incineration for infectious waste that is commonly noticed and addressed in the facilities of different scale.

4. Institutional setup

Evaluating the present institutional setup, regional and national level, their powers on waste management, roles and responsibilities in each country. Collecting information on the standards and guidelines for waste management and heath safety measures followed within the healthcare facilities.

5. Policies, legislations and regulations

Compiling available policies, legislations and regulations covering all the waste management aspects, defining the roles and responsibilities of persons involved in management.

For example, collection of information on the policies in the region such as on safe management of healthcare waste. Collecting information on the legislations including the acts and rules related to waste and healthcare services. Obtaining information on the regulatory documents governing healthcare waste and relevant guidelines.

6. International interventions

Documenting, the involvement of multilateral organizations such as World Health Organization (WHO), the United Nations Environment Programme (UNEP), the Asian Development Bank (ADB). Documenting international collaborative programs, local and regional research institutes relating to healthcare waste.

7. Priority areas

Identifying the priority areas of negotiation such as policy reforms, institutional needs assessment, capacity building needs and awareness programs related subjects on HCW.

DATA SOURCES

Country Representatives' Contribution

Understanding the liability of study and its probable impacts on future decisions, the selection of information sources was essential and limited to ministries and organizations corresponding to healthcare waste for obtaining data. Foremost source of information was the reports and presentations of country representatives' made during the 1st meeting of the Thematic Working Group on Solid and Hazardous Waste, 28-29 February 2008, Singapore. The country representatives were from different organizations, agencies and background related to environment and health sectors. Table (see next page) outlines the countries' respective department's participants to the 1st meeting of the TWGSHW.

The principal source of the documents were from the country representatives who provided significant information on the number and categories of healthcare facilities, current treatment and disposal methods, present institutional setups, available policies and legislation and involvement of multilateral organizations.

Other Sources

In addition to the above, websites of the respective national governments, multilateral agencies and organizations were referred for collecting information. Published literatures in Journals, Periodicals and Policy Briefs served as supplementary source of information in addition to the regional information and the perspectives of regional experts and researchers on HCW. The documents and reports of Regional and International Agencies offered considerable perspectives on the current state of HCW. Wherever possible, information from other sources was verified for its credibility.

Representative Departments to the 1st TWGSHW Meeting

Sector and Country Details	
Department of Pollution Control, Ministry of Environment, Phnom Penh, Cambodia	National Commission for Environmental Affairs Ministry of Forestry, Nay Pyi Taw, Myanmar
Research Institute of Solid Waste Management, Chinese Research Academy of Environmental Sciences, Beijing, China	Environmental Management Bureau Department of Environment and Natural Resources, Quezon City, Philippines
Ministry of Environment, Jakarta, Indonesia	
Waste Management and Recycling Department Ministry of the Environment, Tokyo, Japan	Resource Conservation Department National Environment Agency Singapore
Council of Public Works and Transport Sciences, Ministry of Public Works and Transport, Vientiane, Lao PDR	Pollution Control Department, National Environment Agency, Singapore
Engineering Services Division, Ministry of Health Putrajaya, Malaysia	Waste Management Department, National Environment Agency, Singapore
Corporate Division Ministry of Housing and Local Government Kuala Lumpur, Malaysia	Pollution Control Department, Ministry of Natural Resources and Environment Bangkok, Thailand
Department of National Solid Waste Management, Ministry of Housing And Local Government Kuala Lumpur, Malaysia	Department of Health, Ministry of Public Health, Nonthaburi, Thailand
Ministry of Health, Ulaanbaatar, Mongolia	
School of Public Health, Health Sciences University of Mongolia Ulaanbaatar, Mongolia	Pollution Control Division / Basel and Stockholm Conventions, Vietnam Environment Protection Agency, Hanoi, Vietnam

Contribution of WHO

World Health Organization (WHO), being the most authentic and appropriate source of information on healthcare waste, significantly served as a guideline during this report preparation. It helped in clearly understanding the terms related to healthcare waste. In addition, the complexity that arose while addressing the status under same grounds due to the lack of commonality usage of terms in different countries were made simple from the understanding gained from WHO information. Thus, the information exclusively aided in sustaining consistency throughout this report.

Review Process

Corresponding reports of each country were sent for review to the country representatives. The review comments provided by them in return were incorporated and updated accordingly. The finalized reports after the review were then compiled and evaluated for consistency throughout for easy assessment and comparison of the status among the regions in similar grounds.

STRUCTURE OF THE REPORT

Country Reports

The reports have been designed to first provide an overview of the country following which a profile of the healthcare facilities in the country is provided. The succeeding section of the country report discusses the healthcare waste scenario and management in the facilities. The subsequent section presents current institutional set up and its contribution to the HCWM and the prevailing policies, regulations and legislations. The next section includes multilateral and international organization involvement in HCWM.

Global Experiences and Lessons to Learn

Healthcare waste management is subject matter of knowing what it is and how to handle it. With this understanding a dedicated Chapter on Global Experiences and Lessons to Learn has been provided. This Chapter provides information on methods of healthcare waste management across the world, both from European and other Asian countries. Experiences from good and bad practices on healthcare waste and its management has been provided only as an eye-opener and not with the intention of demeaning the corresponding country.

The Chapter provides light on some non-destructive technologies for healthcare waste management. This section is provided with the idea of bringing to limelight the various non-burn technologies available and clearing the minds that incineration is the only option for managing and disposing healthcare waste.

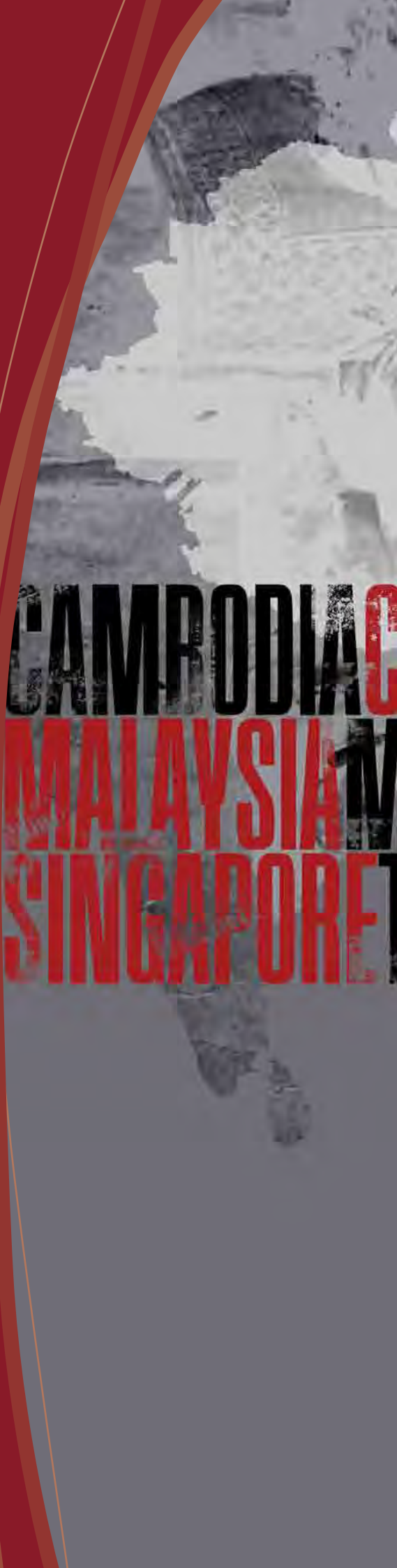
Recommendations

In a study of such scale, involving 12 countries, placing country specific recommendations is beyond practicality as it has to take into account the regional variations and socio-economic disparities. With this idea, the recommendations of this report are inclined towards turning the eyes from looking healthcare waste as a management problem than a technological one. With this perspective, the Chapter places recommendations on some vibrant outlooks for healthcare waste management.

Overall, this report is supposed to be a first of its kind in that it addresses healthcare waste in a regional perspective. No such study involving healthcare waste in 12 countries, with a regional perspective has been ever reported. The contents of the report and its recommendations are expected to make a paradigm shift towards improved healthcare waste management in the region.

3

COUNTRY ANALYSIS




CHINA
INDONESIA
JAPAN
LAOS
MONGOLIA
MYANMAR
PHILIPPINES
THAILAND
VIETNAM

Capital
Phnom Penh

Area
181,040 km²

Population
14.2 million

Population growth rate
1.752%

GDP - per capita (PPP)
$2,100

GDP - real growth rate
7%

(Source: CIA World Fact Book, 2008)

Cambodia, a country in Southeast Asia, borders Thailand to its west and northwest, Laos to its northeast, and Vietnam to its east and southeast. In the south it faces the Gulf of Thailand. The country has a multiparty democracy under a constitutional monarchy and has been administratively divided into 20 provinces and 4 municipalities.

HEALTHCARE FACILITIES

Through the District-based Health System the Ministry of Health (MoH) approved a new system in 1995 to improve and extend primary healthcare. A district-based health system comprises three levels: the first level or the most peripheral is made up of the Operational District serving approximately 100,000 – 200,000 population and consists of a referral hospital and a network of health centers. Each health center covers a population of 8,000 to 12,000. The second level or intermediate level is made up of a provincial hospital and a provincial health department. The third or central level consists of MoH, national institutes, national hospitals, national programs and training institutions. Table below illustrates the distribution of healthcare facilities in Cambodia.

Healthcare Facilities in Cambodia

Type of healthcare facilities	Number of healthcare facilities
National Hospitals	9
Provincial Health Departments	24
Operational District Health Centers	76
Referral Hospitals	69
Healthcare Centers	942

[1] *Healthcare Waste in Cambodia: A Status Report, submitted by Mr. Purnlork Sourn, Deputy Chief Office, Department of Pollution Control, Ministry of Environment Phnom Penh, Cambodia to the Thematic Working Group on Solid and Hazardous Waste*

CAMBODIA[1]

MANAGEMENT OF HEALTHCARE WASTE

Waste generated by healthcare institutions is broadly classified into two categories:

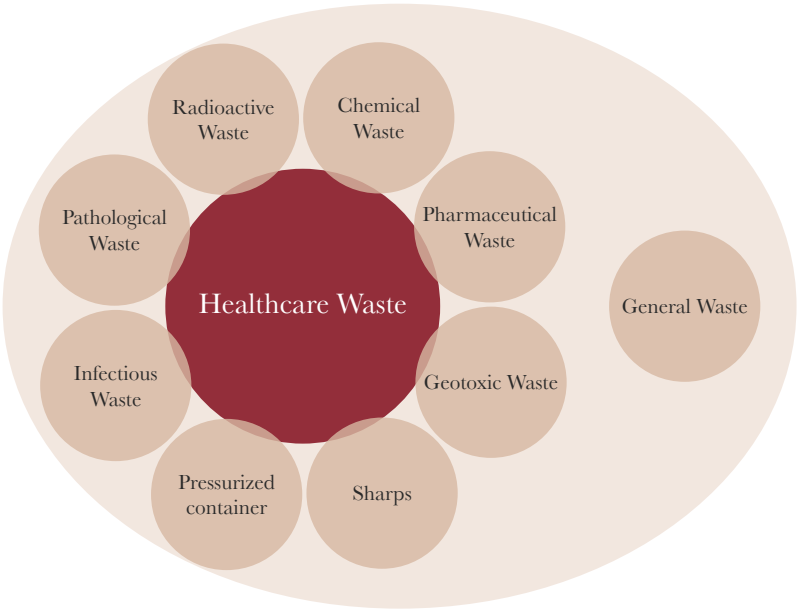
- General waste (non-hazardous waste)
- Medical waste (hazardous waste).

Medical waste is further classified into infectious waste, pathological waste, sharps, pharmaceutical waste, genotoxic waste, chemical waste, pressurized containers and radioactive waste as shown in the Figure on the right.

A study on healthcare waste management was conducted by the Cambodia Environment Association during April-May 2003. Supported by the Japan International Cooperation Agency (JICA), the survey was conducted in 41 medical institutions in Phnom Penh covering four major categories of healthcare institutions including 12 hospitals, 14 polyclinics, 9 clinics, and 6 health centers.

This study estimates a total healthcare waste generation of about 306 kg/day. Table (right) presents waste generation rates for the different types of healthcare facilities studied.

Classification of Healthcare Waste



Healthcare Waste Generation

Type of healthcare facilities	Number of bed	Healthcare waste generated (kg/day)
Hospital	2,593	259
Polyclinic	329	16
Clinic	100	6
Healthcare Centre	92	25
Total	3,114	306

top, above and right: Containers for healthcare waste collection

Collection, Storage and Transportation

The same study indicates that about 37 institutions separate their medical waste from the general waste while the remaining four do not. Few medical institutions use a standard system with containers or colored bags with labels, and different types of labeled containers, while many use other types, such as, plastic water bottles, plastic bags, etc. Daily in-house collection of waste is reported to be carried out in nearly 83% of the medical institutions. Two medical institutions in Phnom Penh City collect their medical wastes more than once per day by a private waste collecting company and transport them to a final disposal site.

In-house collection system is carried out daily adopting a system implemented by the medical institutions themselves. Wastes at the origin are mostly collected in small plastic color coded bins marked with the respective symbols. Workers collect daily primary bins or containers of medical waste, which is mixed with other solid wastes to store them in medium-sized containers or in the places within the premises of the facilities. Some of the primary bins or containers used for general and medical wastes have not been labeled and covered or locked. Figure above shows the commonly used containers for collection of healthcare waste in the studied Cambodian hospitals.

Large hospitals and health centers generally have dedicated places for the storage of wastes while polyclinics and clinics use containers. Waste storage yards are generally open and prone to storm water runoff during rains. The study reports that only two hospitals had cold room facilities to store pathological waste. A private waste collecting company is authorized to collect solid waste in Phnom Penh City. This company has been contracted by 40 medical institutions to collect their wastes and transport them to the final disposal site, while one hospital utilizes the service of Phnom Penh Waste Management (PPWM).

Pit for disposal of used sharps

Treatment and Disposal

Burning of the healthcare waste is the most predominant practice. Some medical institutions treat their wastes in an incineration plant and few institutions burn their medical waste on site and bury them in open dumps, mainly the Stung Meanchey dumping site. With primitive technologies, burning of healthcare waste in a closed chamber is often referred as incineration. Maintenance of proper combustion temperatures, air pollution monitoring and control are often missed in these types of systems. Most of the sharps are disposed in sharps pit, often contained underground chamber with a narrow opening. Figure on the right presents some of the common burning practices in disposing healthcare waste and a typical sharps pit.

Phnom Penh is one of the largest cities of the Kingdom of Cambodia with large populations living in the urban area and therefore the amount of waste generated from medical institutions is much higher than other cities and provinces. There are no treatment facilities for general waste and hence all medical institutions in Phnom Penh mostly dispose their waste at the Stung Meanchey Dumping Site. Most hospitals in Phnom Penh City have their own on-site incinerators for infectious and hazardous waste while some do not apply any treatment.

Incinerators in most of the hospitals and some health centers in Phnom Penh are operated at low temperatures resulting in incomplete combustion making them prone to release of dioxins. Identifying disposal methods for untreated waste is essential in preventing the risks of contamination and spreading of diseases.

Open burning of healthcare waste

top, middle and bottom: Closed combustion chambers for healthcare waste disposal

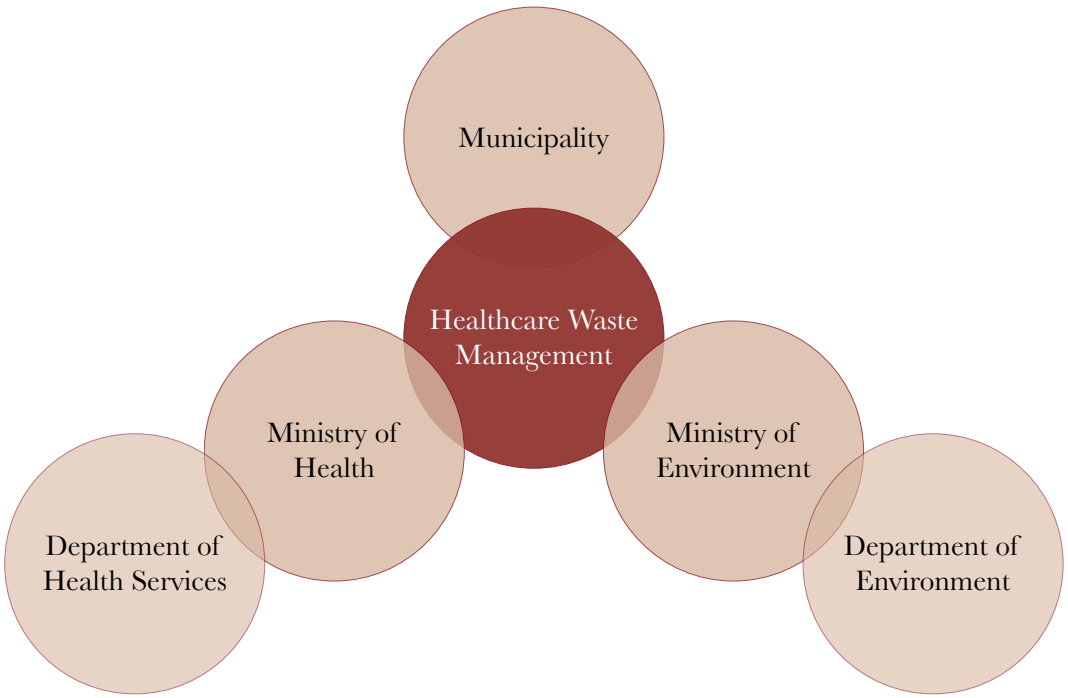
INSTITUTIONAL ANALYSIS

The Figure below shows the institutional setup governing healthcare waste in Cambodia.

The Ministry of Health (MoH) and the Ministry of Environment (MoE) are responsible for the management of healthcare waste. The working groups as well as responsible units on HCWM are the Department of Hospital Services, Phnom Penh Municipality and the Department of Environment Phnom Penh (DoEPP). The responsibilities include:

- Implementation of the HCWM Strategy Plan and System
- Implementation of Hospital HCWM Plan
- Consultation and Implementation of the public health, regulation and policy.

Institutional Setup Governing Healthcare Waste Management



POLICIES AND LEGISLATION

With the ongoing policy and regulatory reforms in the country, the Cambodian government has recently come up with a draft Directive on Healthcare Waste Management. A Law on Pharmaceutical Management has been adopted since 21 June 1996, in addition to the Declaration on Import and Export of Pharmaceutical Products. Until now, there is no specific law, regulation tools and guidelines about healthcare waste management except the draft declaration.

The draft directive provides definitions of all categories of HCW, the requirements for the identification, labeling, and classifications of HCW, and technical requirements for segregation, collection, storage, handling, transportation, treatment and disposal of all categories of wastes generated from healthcare establishments.

INTERNATIONAL AND NATIONAL INITIATIVES

A pilot project on healthcare waste management has been implemented in the National Maternal and Child Health Centre in Phnom Penh and is expected to be extended to the following hospitals:

- National Calmette Hospital
- National Khmer-Soviet Friendship Hospital
- National Prah Kossomak Hospital
- National Pediatric Hospital
- Other designated hospitals in cities/ provinces

Plans to implement the following activities are also on the anvil:

- Develop / design pictograms and a specific sample of containers in national language for medical waste and distribute to some other hospitals
- Provide workshop, training, distribution of posters, stickers, sample bins and sharp containers to promote HCWM
- Provide dedicated healthcare waste collection service based on each cities/ provinces with a high population
- Implement sharps container system
- Provide sustainable treatment including autoclave and shredders for HCW
- Establish a national incinerator based in Phnom Penh to treat wastes of potentially in hazardous nature, e.g. pharmaceutical, cytotoxic, body parts and chemical waste
- Invite WHO, WB, JICA, and other donors by National HCWM Committee for implementation and sustainability of the project.

Capital
Beijing

Area
9,596,960 km²

Population
1,330 million

Population growth rate
0.629%

GDP - per capita (PPP)
$6,100

GDP - real growth rate
9.8%

(Source: CIA World Fact Book, 2008)

The People's Republic of China, commonly known as China extends over a large area in East Asia and shares borders with countries such as Afghanistan, Bhutan, Burma, India, Kazakhstan, North Korea, Kyrgyzstan, Laos, Mongolia, Nepal, Pakistan, Russia, Tajikistan and Vietnam. The country is administratively divided into 23 provinces, five autonomous regions, four municipalities and two Special Administrative Regions, Hong Kong and Macao.

HEALTHCARE FACILITIES

Economic reforms that began in 1978 have ushered China into an era of unprecedented receptivity to foreign influence. The shift to liberalized trade policy led to reduced poverty levels and set China on the path to economic strength. But the reforms also catalyzed massive change within the formerly centralized medical system. Medicine is now the domain of the private sector and provincial and local governments, rather than the national government. The number of hospitals in China has actually grown. In 1980, there were approximately 9,900 hospitals in China. As of 2005, there were about 18,700 (Diep, 2008). A boom in the number of hospitals in such a short span speaks to the changing medical landscape in China. The different types and number of healthcare facilities in China (2006) is shown in Table below.

Healthcare Facilities in China

Type of healthcare facilities	Number of healthcare facilities
Hospitals and Health Centers	60,037
Sanatoriums	264
Clinics	212,243
Specialized Prevention & Treatment Centers or Stations	1,402
Centers for Disease Control and Prevention (Epidemic Prevention Stations)	3,548
Maternity and Child Care Centers	3,003
Research Institutions of Medical Science	248
Other Institutions	28,224

[2] *Healthcare Waste in China: A Status Report, submitted by Dr. Li Li, Research Institute of Solid Waste Management, Chinese Research Academy of Environmental Sciences, Beijing, PRC to the Thematic Working Group on Solid and Hazardous Waste*

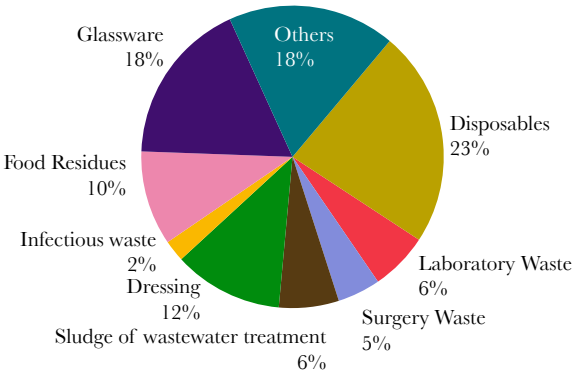
CHINA[2]

MANAGEMENT OF HEALTHCARE WASTE

Healthcare waste in China, according to the Regulations on the Management of Medical Waste, are those waste generated during medical treatment, disease prevention, health protection and other related activities in healthcare institutions, which are directly or indirectly infectious, toxic and harmful. Healthcare waste in China is divided into five broad categories: infectious waste, pathological waste, sharps, pharmaceutical waste and chemical waste as presented in the Figure below.

Classification of Healthcare Waste

Composition of Healthcare Waste in Dongguan City



A study by World Health Organization (WHO) estimates a waste generation rate of about 1.8-2.2kg/bed in which about 80% waste is comparable to non-risk, general domestic waste and about 20% (or 0.36-0.44kg/bed) is healthcare waste requiring special attention. Another survey made by State Environmental Protection Administration (SEPA) for a project titled "Environmentally Sustainable Management of Medical Wastes in China" indicates a healthcare waste generation rate of 0.37kg/bed in 2005, very close to the result reported by the WHO. The same report (UNIDO, 2007) indicates that the Eastern part of China has the highest level of healthcare waste generation approximately 0.50kg, while the Centre has a moderate level of 0.3kg and the West with the lowest of 0.29kg, indicating the relationship with the economic development level of the regions. The composition of healthcare waste varies regionally. Figure above shows the composition of HCW in Dongguan City from the result of a survey conducted from 2000 to 2002. Disposables mentioned in the above Figure refer to abandoned items like syringes.

left and above: Containers for collection of healthcare waste

Other sources of information indicate a daily generation of healthcare waste as low as 1 kg/bed and according to these data, the generation amount of healthcare waste was about 770,000 tons in 2005.

A careful analysis of the healthcare waste generation rates from different data sources indicates almost a 100% variation. Evidently, this variation stems from the differences in the definitions of healthcare waste. In addition when estimations are made, it is essential to provide light on the assumptions and other factors considered, for example the bed utilization rate when projections are made based on the number of beds. Issues arising from difference in the definition are discussed in the subsequent sections of this report.

Results of a study on healthcare waste generation in 23 provinces, organized by SEPA in 2004, showed that 75% of healthcare waste was generated in hospitals. Although the number of other kinds of healthcare facilities is 88% of the total, the waste generated in them was found to be only 25% of the total. Healthcare waste generated by the outpatient unit in healthcare institutions was mostly dressing, bandage and disposable materials. Healthcare waste generated by inpatients was found to be the major source of healthcare waste. The eastern part of China is the most populated and developed with better healthcare facilities than the central and western region. Hence healthcare waste generation in this region is expected to be greater than the other regions of China.

Collection, Storage and Transportation

Healthcare wastes are collected daily from the rooms by appointed laborers. These wastes are separately stored in designated places meeting relevant standards. Waste management companies approved by the local government collect these waste from the healthcare facilities, once or twice a day depending upon the waste generation rate and transport them to the disposal facility. Figure above and below shows containers used for collecting healthcare waste and a typical storage room.

Room for Storage of healthcare waste

In China, packaging bags and containers of healthcare waste are in yellow according to GB/T 3181 and have the symbol on the surface which as shown in the Figure below. The external surface of the healthcare waste transportation vehicle is white or silver gray and has the symbol on the surface as shown in the Figure below. The figure and letter are in black and the background colour is in orange/red.

In Macao, healthcare waste is collected separately and sorted into two categories, contaminated (collected in yellow bags) and non-contaminated (collected in black bags). Non-contaminated waste is collected regularly by the waste management companies and transported to the Macao Incineration Plant.

Symbols to Indicate Healthcare Waste in China

left: Symbol for packaging bags and containers of healthcare waste
center: Symbol for healthcare waste transportation vehicle
right: Symbol for temporary storage site of healthcare waste

Treatment and Disposal

Incineration is the most preferred method of disposing healthcare waste in China. About 5% of the disposal facilities use other technologies such as steam or chemical disinfection.

Before the spread of the Severe Acute Respiratory Syndrome (SARS) epidemic, most of the healthcare institutions in China disposed their waste themselves. Small incinerators with fixed or intermittent furnace were used. These incinerators were simple, mostly without air pollution control equipments and operated at low temperature. These factors contributed to severe secondary pollution and caused strong public resentment as most of the healthcare institutions were near the residential areas. Some institutions disposed healthcare waste in open dumpsites after the addition of lime as simple disinfection or in some cases without any treatment. Some healthcare waste such as disposable syringes was recycled posing risk to the user through use of infected items.

Within a short period after the SARS epidemic, many makeshift incinerators came up. The result of the general investigation organized by the SEPA showed that there were 152 incinerators used during the SARS epidemic with about 77 incinerators in the eastern region, 42 in the central region and 33 in the western region of China. Beijing City, Zhejiang Province and Hebei Province had the most number of incinerators. Constructions of these incinerators were done within a short period and hence the environmental performance of these incinerators was susceptible.

In order to solve the problems related to HCW treatment and disposal, the National Plan for the Construction of Disposal Facilities for Hazardous Waste and Medical Waste was approved by the State Department in December 2003. The National Plan, emphasized on the centralization of the disposal facilities targeted to construct 300 disposal facilities before 2007. This would be expected to increase the disposal rate by 2,080 tons/day. Every city was expected to have a facility. There were 283 cities at the prefecture level before 2006. Facilities designed to handle more than 10 tons/day were encouraged to use rotary kiln and pyrolysis incinerator. Facilities

designed to dispose less than 10 tons/day were recommended to use other techniques with pretreatment such as sterilizing, destroying and decontaminating to prevent secondary pollution. The National Plan was delayed due to lack of technology and market. As on September 2007 there were 108 facilities, either constructed or under construction. The Plan is now been extended for completion before 2009. The investment for the construction of centralized disposal facilities is 1 billion USD (6.89 billion RMB).

INSTITUTIONAL ANALYSIS

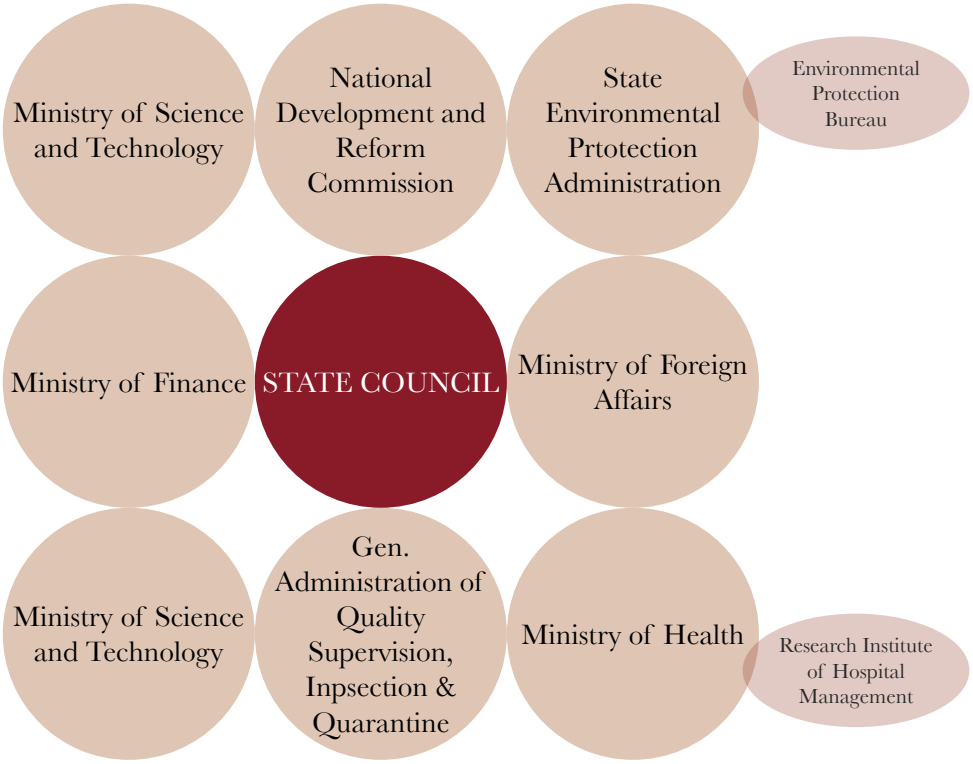
Healthcare waste management in China involves a wide range of government functional departments of comprehensive planning, financing, health, environment, safety, transportation and construction. There are organizations with administrative functions of supervision and administration entrusted by the government such as the National Development and Reform Commission (NDRC), Ministry of Finance (MoF), Ministry of Science and Technology (MoST), Administration of Quality Supervision, Inpsection and Quarantine (AQSIQ), State Environmental Protection Administration (SEPA), Ministry of Health (MoH), Research Institute of Hospital Management (RIHM), Local Environmental Protection Bureaus (LEPB), Local health bureaus at county level and above, Pricing Bureaus and other government functional departments including the monitoring stations, industrial associations and training centres in both health and environment sectors. Figure(far right) shows the institutional setup governing healthcare waste in China. Responsibilities of some of the institutions are presented in the next page.

Ministry of Environmental Protection
As the competent department HCW include: formulating national environmental protection guidelines and policies; developing related environmental standards, environmental protection regulations and programs; organizing work in environmental monitoring, statistics and information; carrying out overall supervision and management on environmental protection of the whole country; participating in international environmental protection activities on behalf of the state.

Ministry of Health
In terms of HCWM, the MoH is responsible for: drafting guidelines and policies on health affairs; participating in formulating relevant laws and regulations; putting forward development plans for the healthcare system; formulating health technical rules and standards, and supervising their implementation. It is also responsible for the overall planning and coordination of health resources allocation for the whole country and guiding implementation of health plans in different regions.

National Development and Reform Commission
As the macro-economy regulatory department, NDRC is responsible for: studying and formulating national economic and social development plans and strategies, keeping overall balance and giving guidance to overall economic institutional reform; developing environmentally friendly industrial policies, and restriction or elimination of outdated production techniques and equipment so as to promote sustainable development strategy. Additionally, NDRC is responsible for the formulation of development policies relating to healthcare; and, together with the concerned department, organize development, replication and facility construction of technologies to HCW disposal.

Institutional Setup Governing Healthcare Waste Management



Ministry of Science and Technology
As the national competent department for science and technology management, it is responsible for: proposing macro-strategies in science and technology development and guidelines, policies and regulations on economic and social development promoted by science and technology; studying and solving important issues regarding economic and social development; identifying the overall arrangements and priority fields of science and technological development; promoting construction of the national science and technology innovation system; and facilitating the establishment of the nation's facility in science and technology innovation and strengthening the national capacity. In this aspect, it is involved in research on technology of healthcare waste disposal and the pollution controlling; and promotion of transformation and application of related scientific results.

Ministry of Foreign Affairs
As the competent department in charge of foreign affairs, it is responsible for controlling the transboundary, movement of HCW.

Ministry of Finance
As the macro-regulatory department in charge of financial revenues and expenses as well as fiscal and tax policies under the State Council, it is mainly responsible for: formulating and implementing national fiscal and tax development strategies, guidelines and policies, mid and long term plans, reform schemes and other relevant policies; participating in formulating of various macro-economic policies; developing annual central budget and final accounts drafts and organizing their implementation; and managing central public financial expenses related to HCWM.

Ministry of Communications
As the competent agencies for communication and transportation administration under the State Council, it is responsible for formulating and supervising implementation of development strategies, guidelines, policies and regulations in communication and transportation related to HCWM.

General Administration of Quality Supervision, Inspection and Quarantine
The General AQSIQ is a department directly under the State Council in charge of national work on quality, metrology, entry-exit commodity inspection, entry-exit health quarantine, certification and accreditation, standardization, etc. It can formulate standards and rules for accreditation to relevant agencies and for certification of municipal waste treatment equipment.

Research Institute of Hospital Management is authorized by the MoH to conduct scientific research on hospital management, train managerial and medical personnel for hospitals, collect and analyze information from international and domestic sources regarding hospital management and provide technical support to the governments and relevant agencies in formulating policy and making decisions.

Local and National Environmental Protection Bureaus, under the Ministry of Environmental Protection (MEP), are responsible for the overall management of hazardous waste and the enforcement of related regulations. Authorized EPBs issue licenses to hazardous waste disposal and treatment sites, which are verified as qualified to handle such waste.

POLICIES AND LEGISLATION

Since 1980's, series of laws, regulations and standards of HCWM have been promulgated in China.

The Regulations on the Management of Medical Waste was promulgated by the State Council in June, 2003. It was the base for the development of the medical waste management system in China. During the SARS epidemic, management of medical waste became very difficult due to lack of technical guidelines and standards for the treatment of HCW and lack of centralised disposal facilities. To solve this problem, the Regulations on the Management of Medical Waste was instituted by the State Council in 2003, based on the Law on Prevention of Communicable Disease enacted in April 1989 and the Law on Prevention of Environmental Pollution Caused by Solid Waste implemented in April 1996. These laws filled up the gap in the management of healthcare waste and brought its management to a higher level.

The main content of the Regulation includes the definition of healthcare waste, its characteristic, the powers and responsibilities of different departments, and the basic measures of management. In the Regulations, healthcare waste is defined to be harmful and is classified as hazardous waste. Hence the regulations and standards for hazardous waste are also applicable to healthcare waste. This enriched the management system of healthcare waste. According to the Regulations, centralized disposal was the most preferred for the management of healthcare waste.

After the promulgation of the Regulations, a series of documents such as guidelines and standards for the management of healthcare waste and the construction and operation of centralized disposal facilities were introduced. Table below lists the laws, regulations and guidelines that constitute the system of healthcare management.

Policies and Regulations Governing Healthcare Waste

	Instrument	Issued by	Date of issuance
Laws	Environmental Protection Law of China	Standing Committee of the National People's Congress	December 1989
	Law of China on the Prevention and Control of Environmental Pollution Caused by Solid Wastes	Standing Committee of the National People's Congress	Entered into force in April 1996; revised in April 2005
	Law of China on the Prevention and Control of Infectious Diseases	Standing Committee of the National People's Congress	September 1989
	Measures for the Administration of Operating Licenses for Hazardous Wastes	State Council	2004
Regulations	Regulations on Management of Medical Waste	State Council	2003
	National Catalogue of Hazardous Wastes	SEPA, the former SETC, the former MOFTEC	July 1998
	Measures for Manifest Management on Transfer of Hazardous Wastes	SEPA	October 1999
	Technical Policy for the Prevention and Control of Pollution Caused by Hazardous Wastes	SEPA	December 2001
	Catalogue of Classified Medical Waste	MoH	2003
	Circular concerning Implementation of Charging System for Disposal of Hazardous Wastes to Promote Industrialization of Hazardous Wastes Disposal	NDRC, SEPA, MoH, MoF, MoC	2003
	Measures for Management on Medical Waste of Medical and Healthcare Institutions	MoH	October 2003
	Measures for Administrative Penalty on Medical Waste Management	MoH	June 2004
Standards and Technical Guidelines	Pollution Control Standard for Hazardous Wastes Incineration (GB18484-2001)	SEPA	January 2002
	Standard for Pollution Control on Hazardous Waste Storage (GB18596-2001)	SEPA	July 2002
	Standard for Pollution Control on the Security Landfill Site for Hazardous Wastes (GB 18598-2001)	SEPA	July 2002
	Technical Standard for Medical Waste Transport Vehicle (GB 19217-2003)	SEPA	May 2003
	Technical Standard for Medical Care Incinerator (GB 19218-2003)	SEPA	May 2003
	Technical Specification for Centralized Disposal of Medical Waste (Trail)	SEPA	2003

Capital
Jakarta

Area
1,919,440 km^2

Population
237.5 million

Population growth rate
1.175%

GDP - per capita (PPP)
$3,900

GDP - real growth rate
5.9%

(Source: CIA World Fact Book, 2008)

Indonesia a country in Southeast Asia, comprises of 17,508 islands and is the world's largest archipelagic state. The country shares land borders with Papua New Guinea, East Timor and Malaysia and is located between the Indian and the Pacific Oceans. Indonesia is administratively divided into 30 provinces, two special regions, and one special capital city district. Following the implementation of decentralization beginning on 1 January 2001, the 440 districts or regencies have become the key administrative units responsible for providing most government services.

HEALTHCARE FACILITIES

Government efforts in providing healthcare facilities, such as hospitals, public health centres and public health sub-centres, have been increasing. Each sub-district in Indonesia has at least one health centre headed by a doctor, usually supported by two or three sub-centres, the majority of which are headed by nurses. Most of the healthcare facilities are equipped with vehicles or motorboats to serve as mobile healthcare facilities and provide services to underserved populations in urban and remote rural areas. At the village level, the Integrated Family Health Post provides preventive and supportive services. These health posts are established and managed by the community with the assistance of healthcare centre staff. Midwives are employed in the villages to improve maternal and child health.

In Indonesia, the number of private-owned and government-administrated hospitals is 652 and 526, respectively. The number of hospital beds has increased from 124,834 in 2001 to 130,214 in 2002. There are 0.6 beds per 1000 population. Table below shows the different type of healthcare facilities in Indonesia.

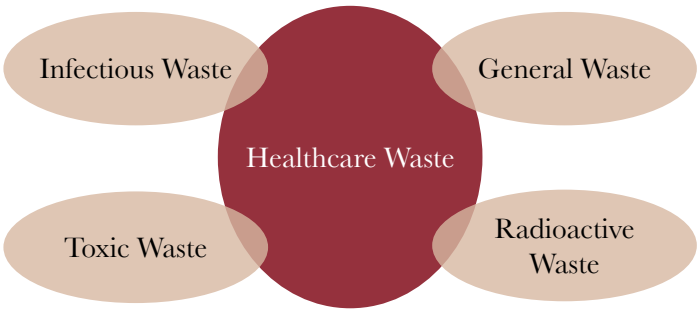
Healthcare Facilities in Indonesia

Type of healthcare facilities	Number of healthcare facilities
Government-administrated	526
Private-owned	652

[3] *Healthcare Waste in Indonesia: A Status Report, submitted by Ms. Haruki Agustina, Head of Subdivision for Forestry Product Industry, Ministry of Environment, Jakarta, Indonesia to the Thematic Working Group on Solid and Hazardous Waste*

INDONESIA[3]

Classification of Healthcare Waste



MANAGEMENT OF HEALTHCARE WASTE

Ministry of Health (MoH) classifies hospital waste as general waste, infectious waste (containing virus or pathogenic bacteria), toxic waste, and radioactive waste as shown in the Figure above.

A study carried out by MoH and World Health Organization in 2003 estimates healthcare waste generation at about 3,895 tons/year. The results of a study under the Program for Appropriate Technologies in Health at Yogyakarta, showed that healthcare waste generated from the healthcare centers was about 0.75 kg/bed/day in 2004. Results of the MoH study in 2003 indicate that the waste composition from healthcare centers is 65% from immunization, 25% from contraception, and 10% from medical curative programs.

Collection, Storage and Transportation

Work on inventory, sorting, segregation, and storage and management of pharmaceuticals is being carried out in a Banda Aceh warehouse in Jakarta. Figure below presents container for collection of used syringes.

Collection of used syringes

Hospitals with Incinerator

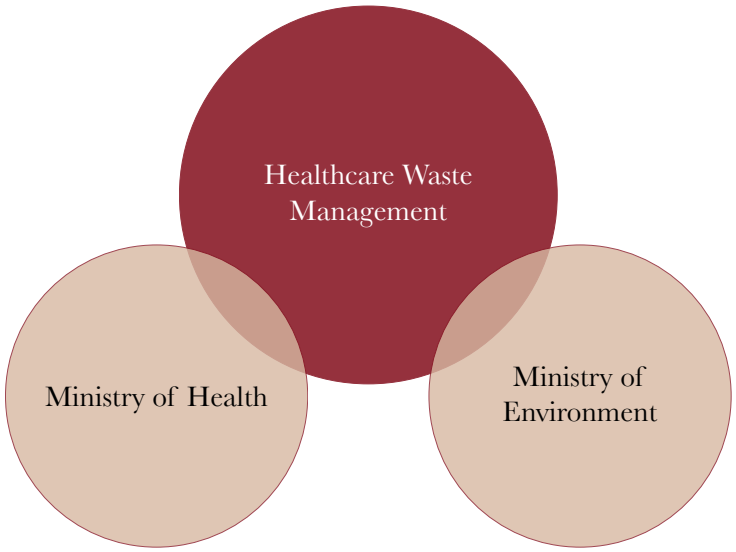
Type of healthcare facility	Number of healthcare facility	Number of incinerator	Functioning incinerator	Non functioning incinerator
Government-administrated	526	230	169	61
Private-owned	652	96	82	14

Treatment and Disposal

According to MoH, more than 500 public and private hospitals in Indonesia do not have treatment plants for their healthcare waste. Some hospitals transport their healthcare waste to other hospitals with treatment facility. In most cases, the treatment facilities owned by the hospitals are limited to incinerators and wastewater treatment plant. As the number of hospitals and their capacities are increasing, the amount of healthcare waste generated also tends to increase. Nearly 10 tons of infectious waste from about 100 hospitals in Jakarta is incinerated everyday. Table above shows hospitals possessing incinerator facility. Figure on the right shows open burning of healthcare waste.

Open burning of healthcare waste

Institutional Setup Governing Healthcare Waste Management



INSTITUTIONAL ANALYSIS

The handling of healthcare waste in Indonesia is controlled by the Ministry of Health (MoH) and the Ministry of Environment (MoE). The responsibilities of MoH is to control and monitor healthcare waste management in a proper manner. The MoE is responsible for issuing permits and licenses on healthcare waste management and applying technology for its treatment to meet national standards. Figureon the left presents the institutional setup governing healthcare waste.

POLICIES AND LEGISLATION

The mission of the healthcare waste program is to reduce and prevent as much as possible the production of HCW and treat the waste in an appropriate manner to prevent environmental pollution and adverse health impacts. The basic principle of healthcare waste management is that the healthcare institutions as generators of waste have the obligation to manage and prevent the impacts that may be caused by the waste, either in terms of costs or in terms of any sanctions to meet the requirements of the law. In 1992, the MoH issued a regulation on National Standards and Guidelines for Hospital Sanitation Management including healthcare waste.

In 1994, the Indonesian Government issued a regulation on management of hazardous wastes. Some of the basic elements are the obligation of the hazardous waste producer to treat the hazardous wastes and transfer the waste to a treatment center and pay for any costs associated with the transportation and treatment required in the event that the producer does not have the capacity or the equipment to treat the waste.

Based on these regulatory frameworks, the National Program for Hospital Sanitation has been involved in the National Health Development Program Five Year Plan VI (1994 – 1999), which had as a target, that all hospitals should be in compliance with the Sanitation Standards within the plan period.

Draft guidelines and standard operating procedures have been developed for pharmaceutical waste management. According to the Government Regulation on hazardous substance management issued in November 2001 the State Ministry acts is the national focal point for hazardous substance management. Before that the MoH managed hazardous substance for hospital. In addition, a separate regulation on monitoring and reporting, storage, transportation, packaging, symbol and labeling, emergency response, as well as the efforts to raise public awareness also exists. This regulation provides registration and notification procedure for producers and importers of hazardous substances.

INTERNATIONAL AND NATIONAL INITIATIVES

WHO is working closely with the MoH, and the Provincial Health Office, North Sumatra, to manage pharmaceutical waste management in Nias and Medan. Studies to prepare the formulation of hospital waste management policy have been initiated. A Hazardous Substance Committee will be established as an independent body to give advice and place recommendations to the Government on hazardous substance management. Table below outlines some of the initiatives in healthcare waste management.

Initiatives in Healthcare Waste Management by Ministry of Health

Program	Action Plan
Management of hospital waste	Training Technical guidance Regulations
Dissemination of hospital waste management to all the stakeholders	Socialization
Working group on managing of medical waste	Discussion and socialization

Capital
Tokyo

Area
377,835 km²

Population
127.3 million

Population growth rate
-0.139%

GDP - per capita (PPP)
$35,300

GDP - real growth rate
0.7%

(Source: CIA World Fact Book, 2008)

Japan is an island country in East Asia. Located in the Pacific Ocean, it lies to the east of the Sea of Japan, People's Republic of China, Korea and Russia, stretching from the Sea of Okhotsk (part of Western Pacific) in the north to the East China Sea and Taiwan in the south. Japan comprises over 3,000 islands making it an archipelago. The country has a constitutional monarchy with a parliamentary government and has been administratively divided into 47 prefectures and 2,216 municipalities (excluding Tokyo's 23 special wards).

HEALTHCARE FACILITIES

Medical facilities in Japan are mainly of two types: hospitals (more than 20 beds), clinics (less than 19 beds). Other facilities include clinical laboratories, midwifery homes, veterinary clinics and laboratories. As of November 2007, there were 8,851 hospitals, 99,641 clinics and 67,869 dental clinics. Table below shows the distribution of healthcare facilities in Japan.

Healthcare Facilities in Japan

Type of healthcare facilities	Number of healthcare facilities
Hospitals (20 or more beds)	8851
Clinics (19 or less beds)	167,510

[4] *Healthcare Waste in Japan: A Status Report, submitted by Mr. Takeshi Sekiya, Head of Taskforce for the 3R Initiative, Ministry of the Environment, Tokyo, Japan to the Thematic Working Group on Solid and Hazardous Waste*

JAPAN[4]

MANAGEMENT OF HEALTHCARE WASTE

Waste generated at hospitals and clinics (medical institutions) are divided into infectious and non-infectious. In Japan, infectious waste materials disposed from hospitals and clinics are defined under industrial waste and also categorized as under hazardous material (Miyazaki and Une, 2005). Healthcare waste in Japan is categorized into four types as shown in Table below.
Wastes with characteristics harmful characteristics to human health and the environment is specified as "specially controlled waste". Among the specially controlled wastes, those with infectious pathogens generated from the healthcare facilities are classified as infectious waste.

According to the amended Waste Disposal Law of 1991, infectious waste is defined as those generated in medical institutions as a result of medical care or research containing pathogens that have the potential to transmit infectious diseases.

Classification of Healthcare Waste

	Infectious Wastes	Non-Infectious
Industrial Wastes	blood, sludge, injection needle, waste oil, X rays fixing solution	plastics, waste glass, rubber etc.
Private-owned		paper, bandage, cotton etc

As specified in the Waste Management Law, the criteria for determining infectious waste from healthcare facilities are judged based on three parameters as below:

1. Configuration or Form of Waste
   Waste materials contaminated with the following are termed as infectious, which could also be from laboratory work or veterinary clinics.
   - Blood and body fluids;
   - Tissues, organs and body parts;
   - Sharp objects contaminated with blood and body fluids;
   - Test equipment and cultures of infectious agents.

2. Site of Generation
   Waste materials are termed as infectious if they are disposed of from: a ward for infectious diseases; an operation theater; an emergency room for out-patients; an intensive care unit; an inspection room such as a pathological and a biological laboratory and an autopsy room.

3. Type of Infectious Disease
   Waste materials relating to all materials used for the treatment and examination of patients with infectious diseases listed under Group 1 to 5 (under the Japanese law on Prevention of Infectious Diseases and Health Care for Patients of Infectious Diseases, 2003 or the Infectious Diseases Law) and tuberculosis, are defined as infectious waste.

The amount of healthcare waste generated as of November 2003, was 1.23 million tons/year of which 285,000 tons were infectious and 945,000 tons were non-infectious waste.

Collection, Storage and Transportation

All infectious wastes are segregated from other wastes. Segregation is done in airtight containers and kept in special storage areas to prevent the spread of infection. Containers are marked with biohazard symbols and labeled with separate color codes. Each label is colored based on the type of waste: labels for blood and body fluids are red, solid materials are orange, and sharp objects are yellow.

Blood and body fluids are collected in anti-leak containers. Double plastic bags are used for collecting solid wastes. Special attention is given to the management of sharp-edged materials, both unused sharp objects and disinfected sharps like scalpel. Sharps are put in tight containers and transported to authorized waste incinerators. This safety measure is necessitated to avoid needle-prick accidents that have been reported by approximately 30% of municipal governments. The colour coding used in Japan is shown in Table below. Some examples of segregated waste are shown in Figure on the right.

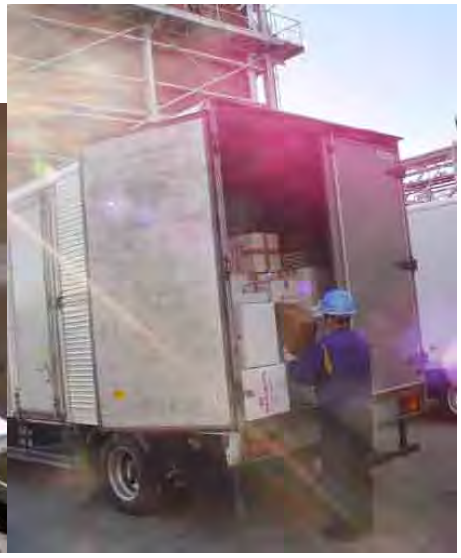
Containers with infectious healthcare waste are transferred and stored in special storage areas for the shortest time possible. A signboard stating "infectious waste" is posted in each storage area and only authorized personnel are granted access. Workers are required to wear gloves and mask while handling the wastes. Workers of the medical institution collect all infectious waste materials from these storage areas and transport them to a restricted place where a special infectious waste management company collects them for further treatment and disposal.

Segregated sharp wastes

Color Code used for Healthcare Waste Collection

Type of waste	Storage	Colour Code
Blood and Body Fluid	Anti-Leak containers	Red label
Solid Waste	Double Plastic bags	Orange label
Sharps	Metal/plastic anti-penetrate containers	Yellow label

Treatment and Disposal



Transportation of healthcare waste

Hospitals and clinics are responsible for the disposal of the waste they generate. Healthcare facilities generally entrust waste treatment to waste management companies authorized by the prefecture government. Around 98% of hospitals outsource the disposal of their healthcare wastes to the treatment company, while less than 0.8% of them are dispose by themselves.

Treatment methods specified by the Waste Management Law are generally incineration, melting in a furnace, sterilization in autoclave or thermal sterilizer, disinfection with heat or other specified methods.

Incineration is the most common treatment method used in Japan. As of March 2006, there were 296 infectious waste treatment companies in Japan of which 90% were incineration companies, followed by 5% of melting disposal companies.

Infectious waste stored in the healthcare facility is collected by the waste management company and transported to an incinerator where the wastes are burnt at more than 800°C for disinfection and disposed. Figure above shows transportation of healthcare waste.

When healthcare facilities entrust their waste treatment to waste management companies, they are to conclude the consignment contract in advance and satisfy the following requirements:

- Licensed Companies
  Healthcare facilities are to consign waste treatment only to licensed companies.
- Documentation
  Both healthcare facilities and waste management companies are to conclude contracts in written format (paper). The contract and attachments are to be stored for five years from the day of completion.
- Manifest
  When a medical facility entrusts its infectious waste management to licensed waste management contractors, they are to issue an industrial management slip (manifest). Manifest is a document which specifies waste's consignee, quantity and type, forwarding with the waste from generators to final disposers. By receiving a copy of manifest which reports the completion of waste treatment from waste contractors, the medical facility can monitor status of the waste and confirm that the entrusted agents treat its waste properly. If a medical facility does not get the manifest back, they are to report to the local governments which monitor and instruct waste management contractors.

The sequence of operation is shown through the flow of a manifest as in the Figure below.

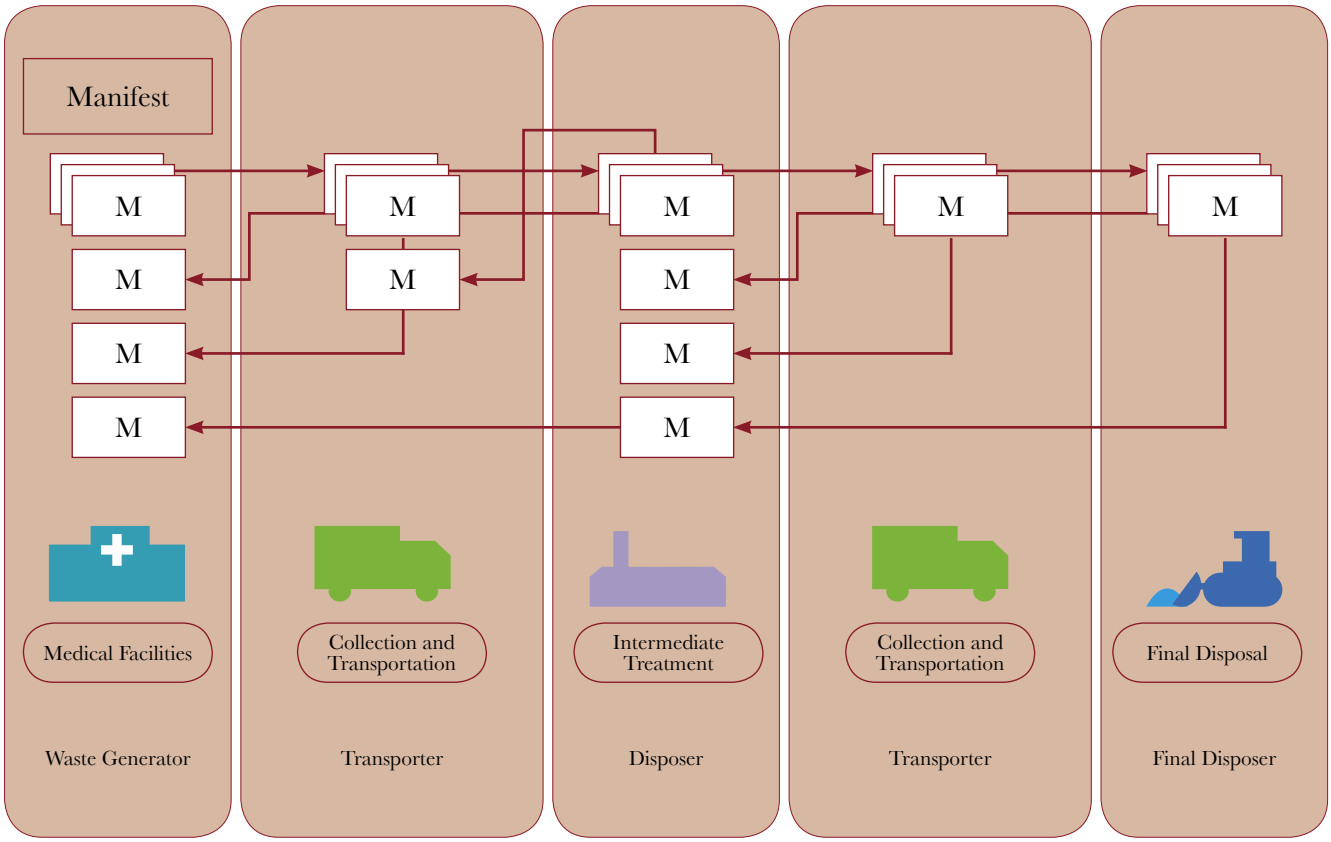
INSTITUTIONAL ANALYSIS

The institutional setup governing healthcare waste management in Japan consists of three levels.

National Government: At the national level, the Ministry of Environment (MoE) is responsible for policy planning and legislation, collecting information, promoting technical development and assisting local governments. The Waste Management and Recycling Department of the MoE consists of three divisions namely,

- *Policy Planning Division*: policy planning for waste generation control, appropriate waste treatment and recycling.
- *Waste Management Division*: municipal waste generation control, appropriate treatment etc.
- *Industrial Waste Management Division*: industrial waste generation control, appropriate treatment, etc.

Flow of Manifest in Healthcare Waste Management System

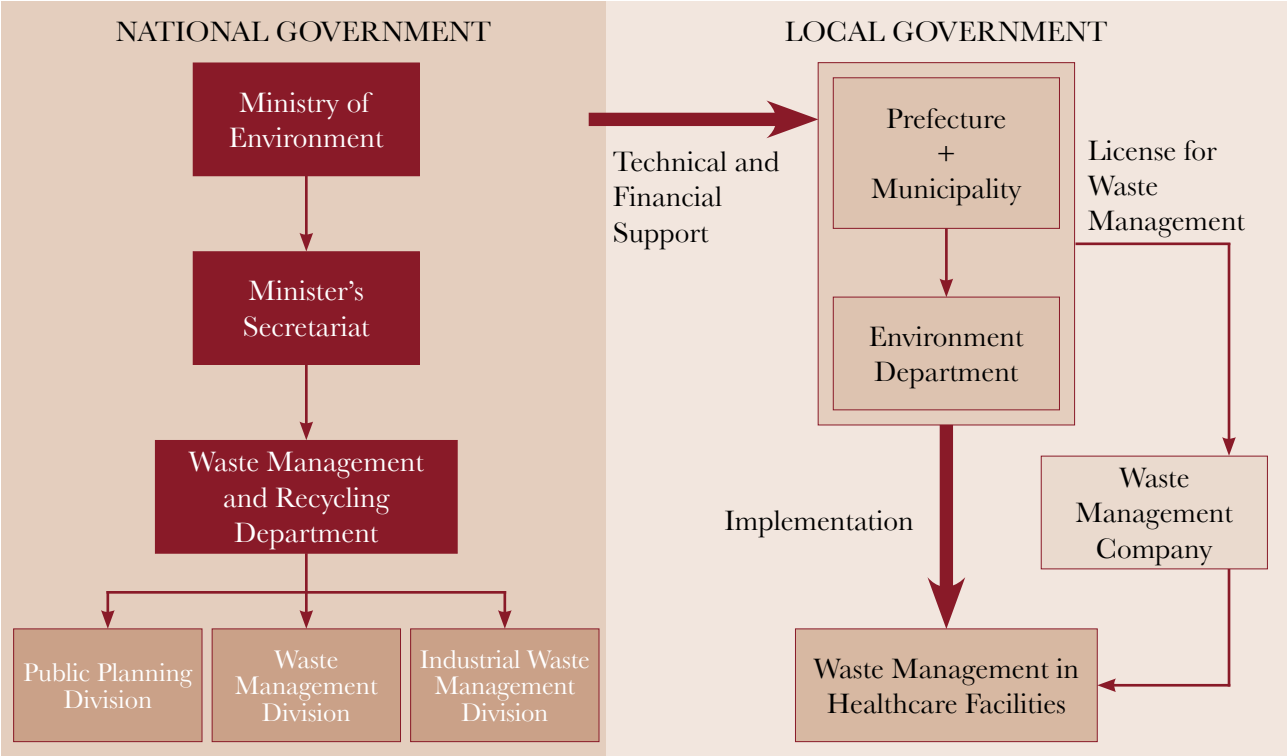


Local Government: Local governments are responsible for implementing the regulations for generators and disposers of waste, including issuing business license and facility license, on-site inspection, administrative punishment and communicating with the waste management company, local residents and other related stakeholders. Local governments enjoy enormous autonomy and functions through their basic units, prefectures and municipalities.

Private sector: Waste generators (hospitals and clinics) are responsible for the disposal of their healthcare wastes in accordance with the regulation. If they do not dispose by themselves, they need to outsource it to a licensed waste management company with fare cost and are to take necessary measure for sound management throughout the sequence of management. Waste management companies are to obtain permission from local government on facility installation and business in waste management and are to observe related regulations.

The institutional setup governing healthcare waste management in Japan is shown in the Figure below.

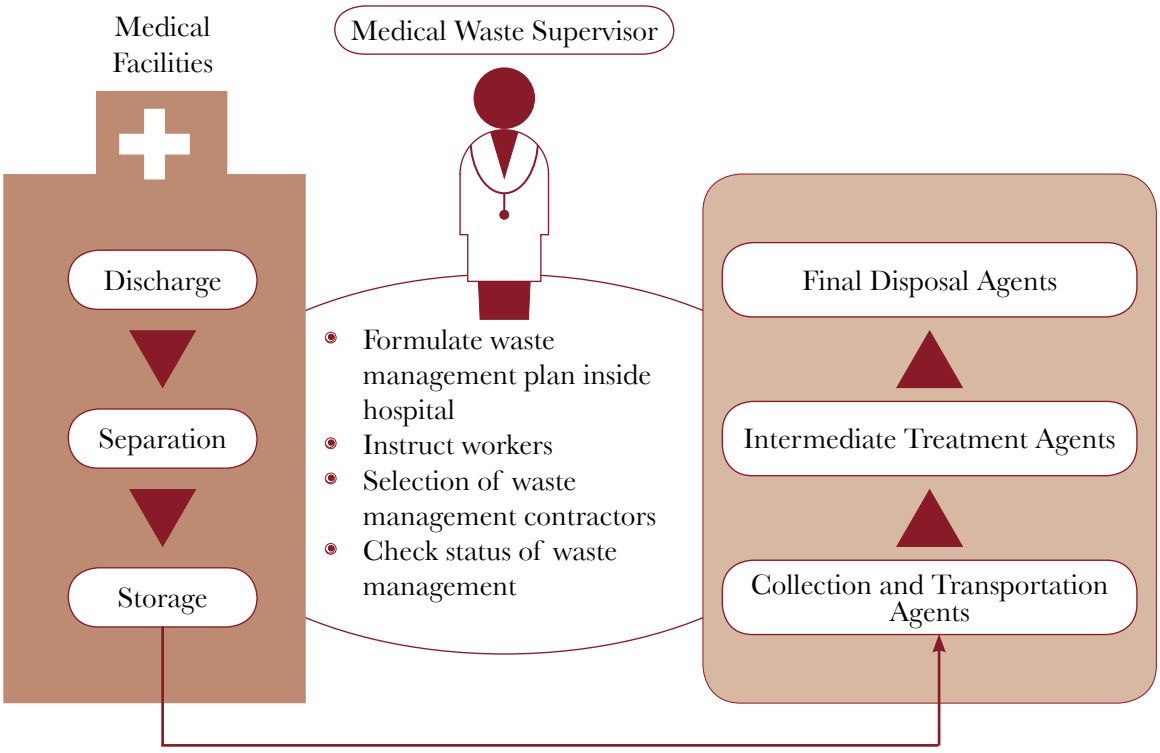
Institutional Setup Governing Healthcare Waste Managment



Japan Medical Association (JMA), an independent body of Japanese physicians, assists in disseminating information to its members to promote sound management of healthcare wastes from hospitals.

Every healthcare facility is required to set up a waste management system. Specifically, it is to appoint a waste supervisor, develop a waste management plan, and record the result of treatment and store them for five years as shown in Figure below.

Flow of Manifest in Healthcare Waste Management System



POLICIES AND LEGISLATION

The Waste Disposal and Public Cleansing Law ("Waste Disposal Law") of 1970 provides the framework for waste management practice in Japan. The Law started regulating all types of medical facilities since 1992. The management of infectious waste materials was regulated in 1992 under the amended Waste Disposal Law of 1991. The Waste Disposal Law was further amended in 2004 and the revised regulation included new criteria for infectious waste management.

The above mentioned law prescribes necessary management structure to control wastes for environmentally sound management. Detailed information on the regulations is available in the "Manual on Sound Management of Infectious Wastes" and is widely used among stakeholders. The manual prescribes procedures for storage, collection, transportation and treatment of infectious wastes.

INTERNATIONAL AND NATIONAL INITIATIVES

Japan Medical Association is very active in promoting proper management of healthcare wastes. One of their main activities is organizing seminars to train medical waste supervisors in healthcare facilities. Japan Medical Association also plays an active role in building networks for small clinics for waste disposal.

Capital
Vientiane

Area
236,800 km²

Population
6.6 million

Population growth rate
2.344%

GDP - per capita (PPP)
$2,100

GDP - real growth rate
6.5%

(Source: CIA World Fact Book, 2008)

Laos is a landlocked country in Southeast Asia, bordered by Myanmar (Burma) and China to the northwest, Vietnam to the east, Cambodia to the south, and Thailand to the west. The country is administratively divided into 16 provinces and one capital city.

HEALTHCARE FACILITIES

Healthcare facilities in Laos can be divided into national hospitals, provincial hospitals, district hospitals, health centers, and private clinics. The number of healthcare personnel has been increasing since 1975, and in 1990 the Ministry of Health (MoH) reported 1,095 physicians, 3,313 medical assistants, and 8,143 nurses. Most personnel are concentrated in Vientiane, where the physician population ratio (1: 1,400) is more than ten times than in the provinces. Table below shows distribution of healthcare personnel at different levels.

Distribution of Healthcare Personnel in Laos

Level of healthcare facility	Number of staff	Female	Male
Central level	2,052	1,235	817
Provincial level	3,598	2,213	1,385
District level	4,273	2,346	1,927
Village level	1,114	548	566

(Source: GRIDC, (2006), Final Report on Lao PDR: Country Gender Profile)

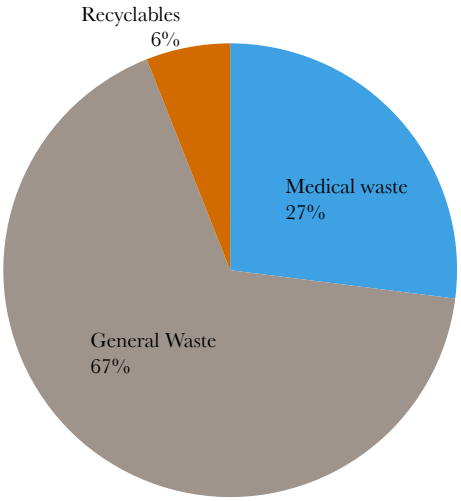
MANAGEMENT OF HEALTHCARE WASTE

Healthcare waste in Laos is divided into three categories; general waste, comparable to domestic waste and not containing any hazardous or infectious substances; infectious waste, suspected of containing pathogens such as tissues (swabs), materials or equipment contaminated with patient's blood or excreta, laboratory cultures; and sharp waste, such as needles, infusion sets, scalpels, blades, broken glass, etc.

[5] *Healthcare Waste in Laos: A Status Report, submitted by Dr. Somphone Dethoudom, Vice President, Council of Public Works and Transport Sciences, Ministry of Public Works and Transport, Vientiane, Lao PDR to the Thematic Working Group on Solid and Hazardous Waste*

LAOS[5]

Composition of Healthcare Waste in State Service Hospital - Inpatient



The amount of medical waste has been increasing along with the improvement in healthcare service since 1990 when the country opened its frontiers to other countries and health organizations. It has been recognized that the amount of healthcare waste is increasing beyond the capacity for its disposal by the existing management systems, especially in rural areas. In Vientiane Municipality, the average amount of healthcare waste was 0.84 kg/bed/day at the national hospital, 1.08 kg/bed/day at the provincial hospital, 0.47 kg/bed/day at the district hospital, and 0.08 kg/bed/day at the health centre. In the total health service area targets (provincial hospitals, district hospitals, health centers, pharmacies, private clinics), the minimum quantity of solid waste is 0.02 kg/day and the maximum is 700 kg/day. The composition of solid waste is 27% medical waste, 67% general waste, and 6% recyclables. The Figure above shows the generally observed composition of healthcare waste.

Collection, Storage and Transportation

Sharp waste segregation is done at all healthcare facilities. Color-coded bags for segregation of infectious waste are used only at the national hospital and in some provincial hospitals. Labels are used at some provincial hospitals. A study in Vientiane Municipality and Bolikhamxay Province reveals two types of storage containers for sharp waste: safety box for used syringes and needles and used infusion bottles. Safety boxes filled with used syringes and needles for immunization are regularly collected by the vaccinators. Containers (infusion bottles) filled with sharp waste from medical treatments are observed to be disposed along with other healthcare waste. Table below shows transport charges of HCW in some HCFs.

Transport Charges for Healthcare Waste

Name of healthcare facility	Type of healthcare facility	Transport charges for healthcare waste (US$/month)
Vientiane Municipality		
Mahosot	NH	312
Sethathirath	PH	186
Naxaithong	DH	3
Saysettha	DH	3
Bolikhamxay Province		
Bolikhamxay	PH	6.5

NH-national hospital, PH-provincial hospital, DH-district hospital

(Source: Phengxay et. al., 2005)

Open Dumping of Healthcare waste (Source: Phengxay et. al. 2005)

Treatment and Disposal

In Vientiane Municipality, the sanitary landfill site operated by the municipality is used by the tertiary hospitals and two district hospitals for final disposal. In Bolikhamxay, the provincial hospital uses a dumping site run by a private company. Figure above shows open dumping of healthcare waste. Few other facilities disposed healthcare waste by open burning. Table on far right shows healthcare waste management scenario in Lao.

INSTITUTIONAL ANALYSIS

In Laos, healthcare waste management is carried out by the Department of Hygiene and the Preventive Pathology (DoHPP) and the Department of Provincial Public Health (DoPPH). The responsibilities of DoHPP are to develop policy and strategy for healthcare waste management and the monitoring and evaluation of its implementation in the country. The Figure on the right presents the institutional setup governing healthcare waste in the country.

The DoPPH is responsible to develop policy, and strategy for healthcare waste management and its direct implementation in the provincial and district hospitals and healthcare centers in the villages.

POLICIES AND LEGISLATION

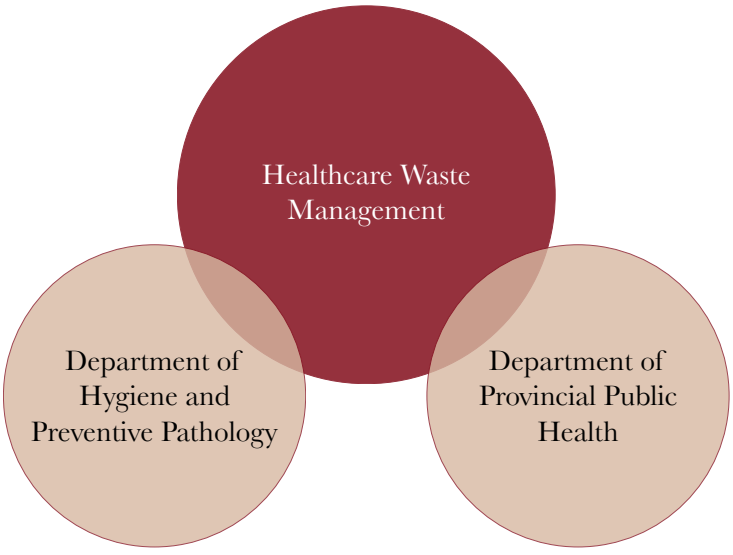
Some existing rules and regulations for the management of healthcare waste in Lao PDR are listed below:

- Law on hygiene, preventive pathology and health promotion
- Guidelines for hospital waste management, 1997
- Ministerial decree on solid waste management in the healthcare service areas
- Regulation on environmental assessment in Laos

INTERNATIONAL AND NATIONAL INITIATIVES

Laos has received aids from international organizations such as JICA, WHO and ADB. The Ministry of Public Health (MoPH) and WHO are jointly promoting a project for the treatment of hazardous and infectious waste in the city.

Institutional Setup Governing Healthcare Waste Management



Name of provinces and municipality	Number of healthcare facilities	Segregation		Final disposal
		Sharp waste	Infectious waste	
Vientiane Municipality	53	NH, PH, DH, HC	NH, PH, DH	SL and/or incinerator (at provincial and district level)
Vientiane Province	29	PH, DH, HC	PH, DH	DS and/or incinerator (at provincial level)
Phongsaly	20	PH, DH, HC	Using label at provincial level	DS
Luangprabang	56	PH, DH, HC	Some wards at provincial level	SL
Xiengkhuang	48	PH, DH, HC	PH, DH	DS
Houaphan	30	PH, DH, HC	PH	DS
Oudomxay	47	PH, DH, HC	Using label at provincial level	DS and/or incinerator (at provincial level)
Luangnamtha	22	PH, DH, HC	Using label at provincial level	DS and/or incinerator (at provincial level)
Xayabury	60	PH, DH, HC	PH	DS and/or incinerator (at provincial level)
Bolikhamxay	33	PH, DH, HC	Some wards at provincial level	DS
Khammuane	70	PH, DH, HC	Some wards at provincial level	SL
Savannakhet	99	PH, DH, HC	PH	SL and/or incinerator (at provincial and district level)
Saravane	33	PH, DH, HC	PH	Incinerator (at provincial and district level)
Sekong	12	PH, DH, HC	No	Incinerator (at provincial and district level)
Attapeu	24	PH, DH, HC	No	Incinerator (at provincial and district level)
Champasack	68	PH, DH, HC	PH	SL

NH-national hospital, PH-provincial hospital, DH-district hospital, HC-health centre, SL-sanitary landfill, DS-dumping site, and DH-some district hospitals

(Source: Phengxay et. al., 2005)

Capital
Kula Lumpur

Area
329,750 km²

Population
25.2 million

Population growth rate
1.742%

GDP - per capita (PPP)
$15,700

GDP - real growth rate
5.5%

(Source: CIA World Fact Book, 2008)

Malaysia is separated into two regions, Peninsular Malaysia and Malaysian Borneo, by the South China Sea. The country borders Thailand, Indonesia, Singapore, Brunei and the Philippines and is administratively divided into 13 states and 3 federal territories. Eleven of the states are in the Peninsular Malaysia and two states, Sabah and Sarawak, in the island of Borneo. The three federal territories comprise of Putrajaya (the government administrative centre), Kuala Lumpur (the capital city), and the island of Labuan (located off the southwest coast of Sabah).

HEALTHCARE FACILITIES

Healthcare services in Malaysia are offered through public and private hospitals. General health and dental clinics established by the Ministry of Health (MoH) offer service in public hospitals category and licensed private hospitals, maternity homes and registered clinics in the private sector. Clinics are intended to provide primary medical care or outpatient care to the public. Apart from the general services, both the public and private hospitals provide secondary and tertiary (specialist) medical care such as open heart surgeries, organ transplants, cancer and other modern treatments. Table below presents the healthcare facilities in Malaysia.

Distribution of Healthcare Personnel in Malaysia

Type of Healthcare Facilities	Number of healthcare facilities
Hospitals	379
Government-owned Private-owned	147 232
Other Healthcare Facilities	
Clinics (Government-owned)	>3000

[6] *Healthcare Waste in Malysia: A Status Report, submitted by Mr. Khew Swee Lian, Director, Engineering Services Division, Ministry of Health, Putrajaya, Malaysia to the Thematic Working Group on Solid and Hazardous Waste*

MALAYSIA[6]

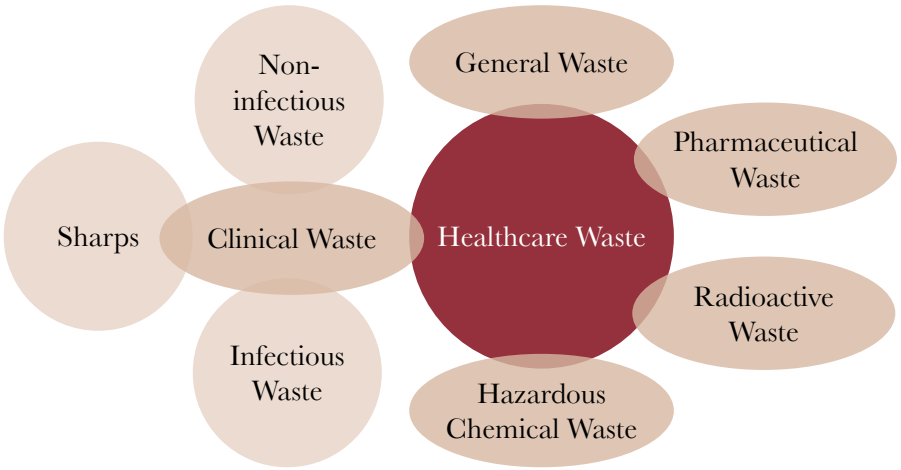
MANAGEMENT OF HEALTHCARE WASTE

Healthcare waste in Malaysia comprises of clinical, pharmaceutical, hazardous chemicals, radioactive and general waste. At present, clinical waste is reported together with pharmaceutical waste. The total clinical waste generated from the 147 public hospitals and other healthcare institutions under MoH is about 8000 tons/year. It is estimated that only 30% of the healthcare waste from private hospitals and clinics enter the appropriate waste stream. Figure below presents the classification of healthcare waste in Malaysia. A study on the composition and characteristic of healthcare waste is ongoing and expected to be completed by the end of 2008.

Color Code for Healthcare Waste

Type of waste		Storage	Colour Code
Clinical waste	Non-Infectious Waste	Plastic Bags	Yellow
	Infectious Waste	Plastic Bags	Light Blue
	Sharps	Bins/ Drums	Yellow
General Waste		Plastic Bags	Black

Classification of Healthcare Waste



Collection, Storage and Transportation

All healthcare wastes are to be segregated at source. Separation of the waste is done by using different colour codes for waste bins and plastic bags. The colour coding used in Malaysia, in line with the international standards is given in the Table above.

Bags for the storage and transport of clinical waste are to conform to the following standards:

- Bags with low density material are to be of 55 microns or 25 microns if of high density materials or of equivalent standard of the container. Storage bags should fit the container properly.
- Clear marking of ownership, biohazard symbol and route of disposal are to be made on the bags.
- Yellow bags used for healthcare waste are generally of capacity 5, 10, 30 and 100 litre.

Double bags are recommended to be used for healthcare waste from high risk areas, such as infectious diseases and quarantined nursing units, labour rooms and operation theatres. Infectious wastes from laboratory are to be autoclaved in blue bags and then packed into yellow bags before transferring them to wheeled bins. Yellow bags and wheeled bins used for collecting and transferring non infectious healthcare waste in Malaysia are shown in Figure below.

Plastic bags and wheeled bins with non-infectious healthcare waste

Bins or drums are used for the disposal of syringes and needles, broken glasses, ampoules and other sharp objects. Bins commonly used for sharps are sealable, single-use polyethylene (or polypropylene) and are incinerated together with their content. Sizes of bins vary between 2.5, 5, 10 and 20 litre. Smaller bags and bins are used in the wards while bigger sizes are used in operation theatres, emergency and labour rooms.

Special requirements are imposed by the Department of Environment (DoE) on the storage period of healthcare and hazardous waste. Healthcare wastes are to be stored in specially designed cold rooms if the storage period is for more than 48 hours, with a maximum storage of 72 hours prior to incineration. Hazardous chemical wastes can be stored at user's premises for less than six months.

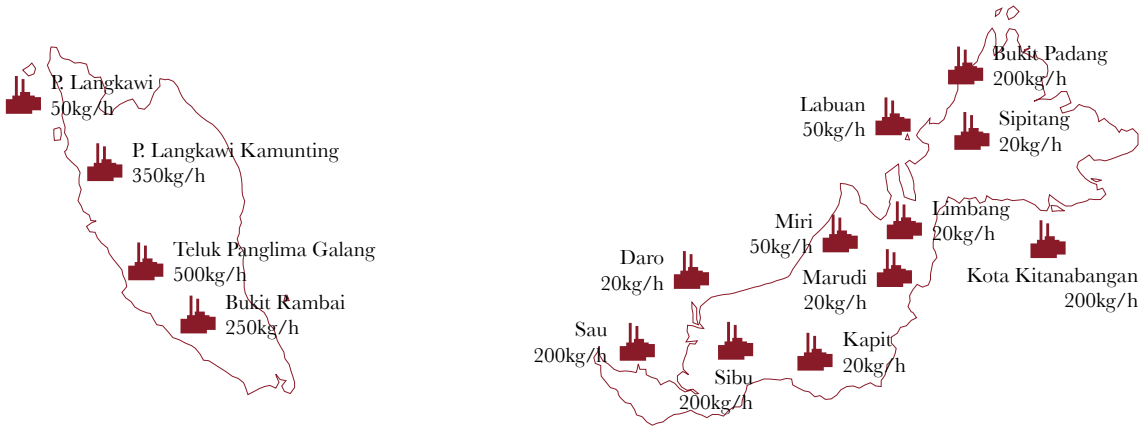
Specially designed and approved trucks are used to transport all the healthcare waste. Operators of the vehicle are to obtain special permits before using the vehicle for transportation of healthcare waste. Transportation schedules are carefully arranged so that no clinical waste is stored for more than 48 hours at the healthcare facilities. As per the Environmental Quality Act and Regulation, a consignment note has to be submitted by operators to ensure that all clinical waste generated from healthcare facilities reach the approved disposal sites.

Treatment and Disposal

All healthcare wastes are to be disposed by incineration at the approved sites, regulated by the DoE. There are 13 approved incinerators in Malaysia which are regularly monitored by the DoE. Three of them, located in Peninsular Malaysia, are designed at a regional scale with a minimum capacity of 250 kg/h. The Figure below shows the location of incinerators in Malaysia.

Hospital radioactive waste is primarily generated from two sources, unsealed and sealed sources. The unsealed source is normally short-lived and is in the form of liquid radionuclide used on patients with dosage not more than 30 mCi (milliCurie). Treated patients are to be placed in a special ward and all the used radio-pharmaceutical discharges are to be drained to a special delay tank for a period of a tenth of half-life, before finally being discharged into the sewer. Waste from sealed sources is to be sent back to the country of origin or to an approved disposal site. Monitoring of this waste is carried out by hospital staff with nuclear medical facility.

Location of Incinerators in Malaysia



Generally two types of incinerators are used, double chamber and rotary. Double chamber incinerators have been found to be more efficient and effective in treating healthcare waste compared to the rotary incinerator. Flue gas emissions are measured at regular intervals and are submitted and verified by the DoE before the annual renewal of the license. Ash is sent to landfill for disposal.

Hazardous chemical waste is separately collected and sent to a designated disposal facility owned by a government listed company, under the purview of the DoE.

The general or solid waste is to be collected by the contractor daily from the storage bins in the hospitals and sent for final disposal. General waste collection is under the responsibility of the Department of National Solid Waste Management.

The handling fees for healthcare waste from source to disposal site vary from 0.61 USD (RM 2) to 1.84 USD (RM 6) per kg. For other hazardous waste, the service fee rates are divided into service rates for treatment and disposal varying from 245 USD (RM 800) to 1225 USD (RM 4000) per tonne and for packaging and transportation varying from 20 USD (RM 66) to 70 USD (RM 230) per tonne.

INSTITUTIONAL ANALYSIS

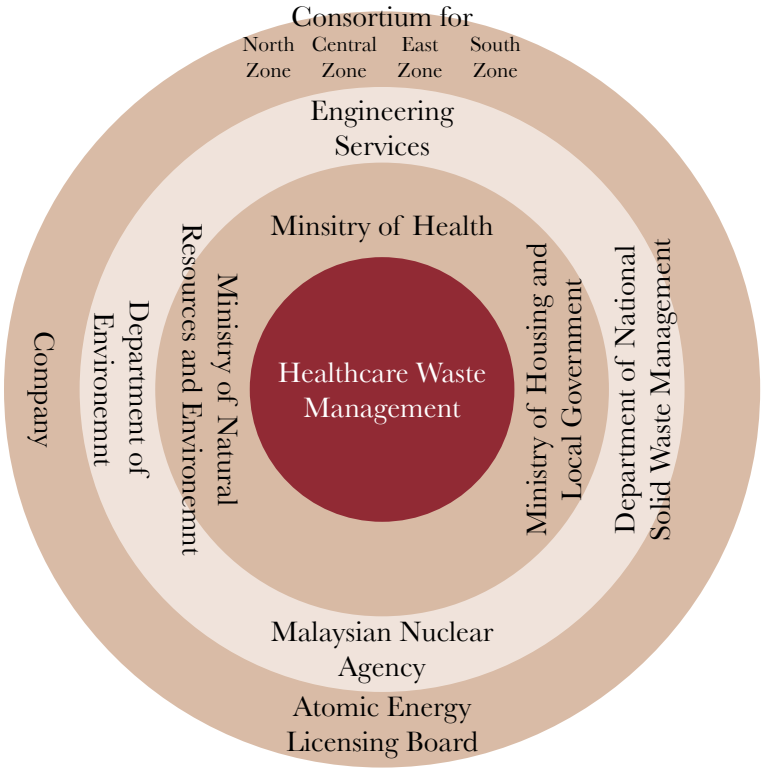
Healthcare waste management in Malaysia was initiated by the MoH in 1996 through agreements with three private consortiums for managing the healthcare, pharmaceutical and general wastes of the northern, central, eastern and southern zones. The central zone comprises of five states the Federal Territory, Selangor, Pahang, Terengganu and Kelantan while the north zone comprises of four states Perak, Penang, Kedah and Perlis. The south zone consists of three states Negeri Sembilan, Malacca and Johor while the east zone consists of two states Sabah and Sarawak, including Labuan Island.

The objective of the initiative was to manage all healthcare waste arising in the public hospitals through a central government privatization strategy involving the government hospitals and other healthcare institutions. In the late 90s, the service was extended to collect healthcare waste from all small government clinics throughout Malaysia. By the end of 2006, the number of government hospitals served was 147 and while the clinics was more than 3000. The infrastructure to handle healthcare waste was also planned and designed to accept waste from the private hospitals. After the approval of the Private Healthcare and Facilities Act by the Parliament, necessary steps were taken by MoH to extend the Clinical Waste Management System (CWMS) to the private hospitals as part of the licensing requirement. The national target is set to capture 50% of the country's private hospital healthcare waste for proper management and disposal by 2010.

Under the Clinical Waste Management System the DoE has licensed the same three concessionaires appointed by MoH to provide services for public and private sector hospitals. Healthcare waste is managed under the CWMS and general waste under the Cleansing Services (CLS). The three companies have more than 15,000 staffs including managers, supervisors and general workers for their daily activities under CWMS and CLS.

Hazardous wastes known as "scheduled wastes" in Malaysia are regulated by the DoE, under the Ministry of Natural Resources and Environment (MoNRE). At present, the DoE has given exclusive right to a company to manage all hazardous waste, from central storage to treatment and final disposal. Operators or contractors dealing with hazardous waste need to be licensed for transportation, treatment and disposal services. The management of hazardous chemical waste is managed by one or two hospital staffs. They are appointed on a case to case basis when needed, for the collection, storage and disposal of the waste to the approved site.

Institutional Setup Governing Healthcare Waste Managment



All hospital managers and concession companies are to report all the healthcare waste details to the Engineering Services Division of MoH every month and from there the national planning and reporting are to be made available to all interested parties.

The Department of National Solid Waste Management under the Ministry of Housing and Local Government is responsible for the management of general waste.

Malaysian Nuclear Agency (MNA) and Atomic Energy Licensing Board (AELB) are the two main agencies that manage the disposal of radioactive waste under the Atomic Energy Licensing Act 1984; but the monitoring and licensing of all the radioactive medical devices in healthcare facilities are given to MoH through delegation of powers provided under the same act. Radioactive waste is being managed by the respective suppliers regulated by the AELB. Nuclear Malaysia Training Centre within MNA provides training programs on Radiation Safety and Health, Environmental Safety and Health and Medical X-ray based on demand and needs of the relevant organizations.

The institutional setup governing healthcare waste in Malaysia is presented in the Figure above.

POLICIES AND LEGISLATION

Until the 1980s, Malaysia had no proper system for the management of healthcare waste. The emergence of HIV initiated the revision of policies and guidelines for the prevention and control of infectious diseases and healthcare waste handling.

The MoH in collaboration with the DoE took initiatives to include clinical waste in the category of scheduled waste, as defined in the Environmental Quality (Scheduled Wastes) Regulations, 1989 under the Environmental Quality Act. All transportation and disposal of hazardous or scheduled waste is to be regulated under this Act.

A system of reporting the waste inventory to DoE using standard consignment notes has been made mandatory since the above regulation was first imposed. Now the system has been elevated to e-consignment notes. Non-compliances are subject to penalty under the Environmental Quality Act.

All management responsibilities and legal framework of the healthcare waste is spelt out in the Management Guidelines of Clinical and Related Wastes in Hospitals and Healthcare Establishments. The guideline was drafted by the Engineering Services Division in 1993 and is fully complied by the three concessionaires. Further, an Action Plan for Waste Management in Hospitals and Healthcare Establishments was drafted to assist the MoH staff and health professionals to oversee and manage healthcare waste in a proper manner. However, the legislation governing healthcare waste is the Environmental Quality Act through the Environmental Quality (Scheduled Waste) Regulation.

The Occupational Safety and Health Act passed in 1994 paved way to the legislative framework for the development of comprehensive CWMS in government hospital and healthcare environment.

The Private Healthcare Facilities and Services Act 1998 and its related regulations is used to impose all the necessary requirements from time to time for regulating waste management within private healthcare facilities. At present, for any private entity to obtain or renew license to practice and operate a healthcare facility or hospital, one of the conditions they need to produce is an agreement with any of the three concession companies to manage the clinical waste. For small medical practitioner's clinics, it is mandatory to register with MoH. Awareness program on healthcare waste management to private hospitals is ongoing and the effort is initiated by MoH, DoE and medical professional bodies.

A new law titled "Solid Waste Management and Public Cleansing Act" has been passed by the Parliament for the management of general or solid waste. This new act was proposed to enforced in April 2008 and all public healthcare facilities are in preparation to comply with the requirements. Table below outlines some of the regulations governing healthcare waste in Malaysia.

Policies and Regulations Governing Healthcare Waste in Malaysia

Type	Policy/Legislation
Radioactive Waste	Atomic Energy Licensing Act 1984
Hazardous Waste	Environmental Quality (Scheduled Wastes) Regulations under the Environmental Quality Act 1989
Clinical/Pharmaceutical Waste	Environmental Quality (Scheduled Wastes) Regulations Private Healthcare Facilities and Services Act 1998 Management Guidelines of Clinical and related Wastes in Hospitals and Healthcare Establishments 1993 Action Plan for Waste Management in Hospitals and Healthcare Establishment 1993
General/Solid waste	Solid Waste Management and Public Cleansing Act 2007

Capital
Ulaanbaatar

Area
1,564,116 km^2

Population
3.0 million

Population growth rate
1.493%

GDP - per capita (PPP)
$3,300

GDP - real growth rate
9.9%

(Source: CIA World Fact Book, 2008)

Mongolia, a landlocked country in East and Central Asia, borders Russia to the north and People's Republic of China to the south, east and west. The country is administratively divided into 21 provinces and one municipality.

HEALTHCARE FACILITIES

Healthcare services are provided at primary, secondary and tertiary levels in Mongolia. At the primary level, services are provided by Family Group Practices (FGPs) and village hospitals. At the secondary level, services are provided by district hospitals and outpatient clinics. Specialized hospitals provide services at the tertiary level. Management of healthcare services is the responsibility of the Aimag (province) and City Health Department, under the local Governor's Office. The management of tertiary level hospitals is under the Ministry of Health (MoH). Table below presents a profile of the healthcare facilities in the country in 2005.

Healthcare Facilities in Mongolia

Type of healthcare facilities	Number of healthcare facilities
Primary level healthcare facilities	570
Secondary level healthcare facilities	34
Tertiary level healthcare facilities	20
Maternity hospitals	3
Private in-patient hospitals	160
Private out-patient hospitals	523
Other hospitals	56

[6] *Healthcare Waste in Mongolia: A Status Report, submitted by Dr. Enkhjargal Gombojav, Lecturer, School of Public Health, Health Sciences University of Mongolia, Ulaanbaatar, Mongolia to the Thematic Working Group on Solid and Hazardous Waste*

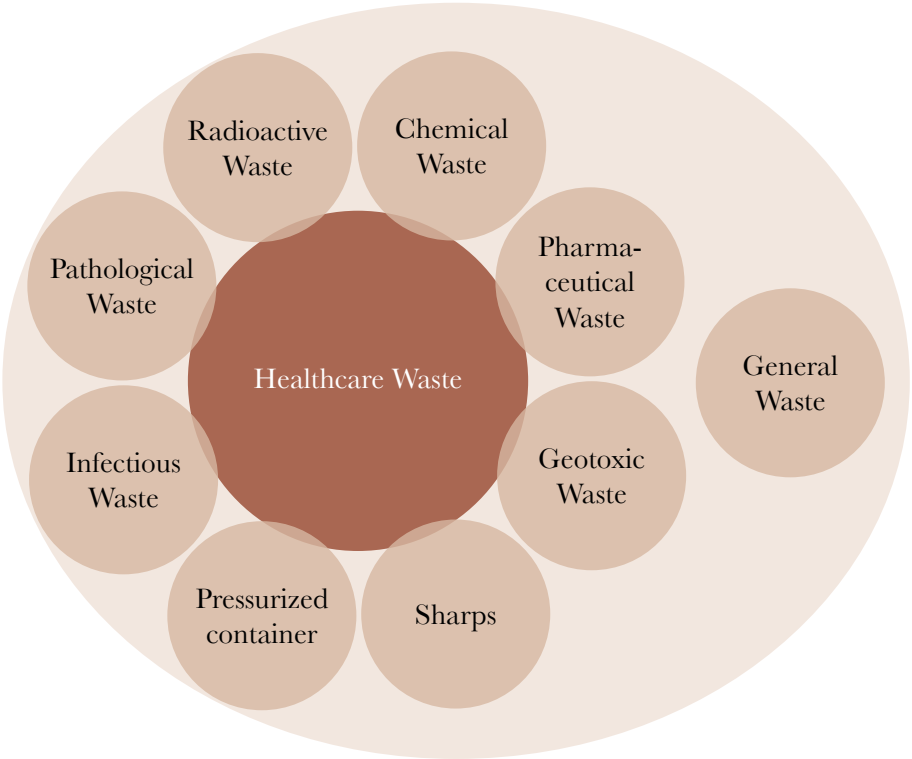
MONGOLIA[7]

MANAGEMENT OF HEALTHCARE WASTE

Healthcare waste in Mongolia is divided into two broad categories, general wastes and healthcare wastes. Healthcare wastes in turn is subdivided into infectious waste, sharps, pharmaceutical waste, genotoxic waste, pressurized containers, radioactive waste, pathological and chemical wastes as shown in Figure below.

As of 2005, About 2.65 tons of healthcare waste was produced every day in Ulaanbaatar (0.78 tons of medical waste and 1.87 tons of general wastes). Healthcare waste generation rate in the inpatient services of public healthcare facilities is observed to be about 1.5-3 times higher than in the outpatient services. The outpatient facilities generated between 0.01 and 0.14 kg of medical wastes and between 0.01 and 0.79 kg of general wastes per patient/day. Inpatient facilities generated between 0.03 and 0.14 kg of medical wastes and between 0.12 and 0.38 kg of general wastes per patient/day.

Classification of Healthcare Waste



Waste generation at Healthcare Facilities in Ulaanbaatar

Type of healthcare facility	Total quantities of wastes generated (kg/day)		
	Medical	General	Total
Family health centers	49.19	81.66	130.85
Soum health centers	1.20	2.68	3.88
District health centers			
-with beds	70.88	164.15	235.03
-without beds	33.64	73.55	107.19
District hospitals	2.27	14.48	16.76
State hospitals	105.76	573.33	679.08
Specialized hospitals	51.40	288.18	339.59
Maternity hospitals	4.70	9.58	14.28
Other healthcare facilities	80.99	448.29	529.28
Private hospitals			
-inpatient	4.52	51.11	55.63
-outpatient	95.15	161.03	256.18
Emergency center and occupational health center	0.18	1.25	1.43
Subtotal	499.89	1,869.28	2,369.16
Forensic center - autopsies	281.55	4.54	286.10
Total	781.44	1,873.82	2,655.26

(Source: Enkhtsetseg et al., 2005)

Waste Generation at Village (Soum) Hospital

Type of waste	Waste quantity (kg/week)
Infectious waste	6.90
Pathological waste	13.38
Sharps	7.97
Pharmaceutical waste	6.88
Genotoxic waste	1.10
Chemical waste	2.04
Wastes with high content of heavy metals	57.40
Pressurized containers	1.47
Radioactive waste	2.0

Waste generation rate in the healthcare facilities of Ulaanbaatar was lower than in some other countries; however, the percentage of medical wastes in the total waste stream was comparatively high, ranging from 12.5% to 69.3%, which indicated poor waste handling practices. The Table on the top left presents the estimated medical and general waste generation for all HCFs in Ulaanbaatar. Annual projections show that the healthcare facilities in Ulaanbaatar produced about 781 kg of medical wastes and 1874 kg of general wastes. The average amount and types of HCW generated in the Soum hospital is shown in the Table bottom left.

Composition of Healthcare Waste in State Service Hospital - Inpatient

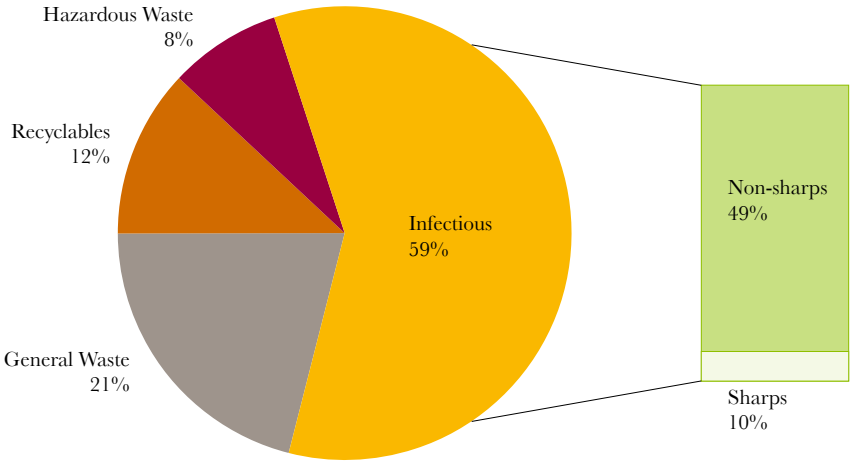
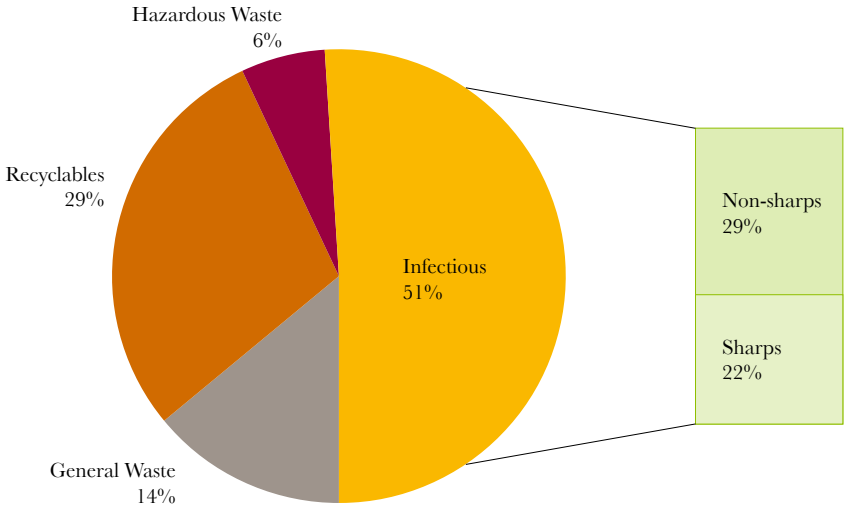
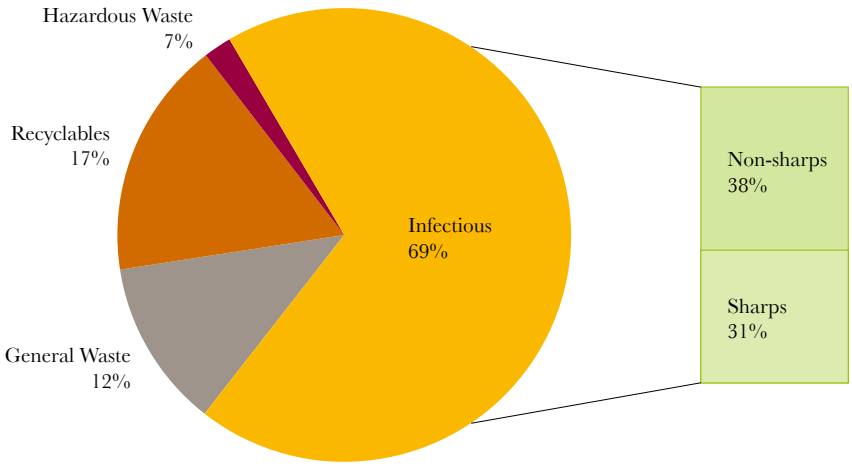


Figure above and right show the composition of healthcare waste in the State service hospital (inpatient) and (outpatient) respectively. Figure below shows composition of medical waste in private healthcare facility.

Composition of Healthcare Waste in State Service Hospital - Outpatient



Composition of Healthcare Waste in Private Healthcare Facility



Safety box for storage of syringes

Color coded healthcare waste containers

Collection, Storage and Transportation

In most healthcare facilities wastes are segregated according to their characteristics mainly into the following categories: sharps, infectious wastes, pathological wastes and pharmaceutical wastes. Results of questionnaire survey in 2005 shows that 96.1% of the surveyed healthcare facilities collect the general wastes in black bags, 93.2% collect the medical wastes into yellow bags, 82.5% collect highly infectious wastes into red bags, and 97.1% use safety boxes for storage of syringes. Figure on top right shows color coded healthcare waste containers and Figure on the right depicts labeled HCW containers. Safety box for storage of syringes can be seen in Figure above.

Although a system of color coding or labeling of waste containers or bags has been adopted, not all facilities strictly follow the national regulations to practice the color-coding system. In some healthcare facilities wastes are collected and stored in plastic bags, paper bags or cardboard boxes. The Table on the right shows the type of waste and the corresponding color coded storage materials.

Of the hospitals surveyed in Ulaanbaatar, 67% have a temporary storage place for wastes, 28.2% do not have such place while 3.9% did not respond to the question. About 49.5% of facilities store healthcare waste for nearly 24 hours, 26.2% store for 2-3 days, 3.9% store for 4-5 days, 13.6% store for 6-7 days and 2.9% store more than 7 days. Figure on the right shows transportation of healthcare waste.

Labeled healthcare waste containers in Village (Soum) Hospital

First one is for general wastes and second one for medical wastes. In some rural areas segregation is only two categories.

Color Code for Healthcare Waste

Type of waste	Storage	Color code
Sharps (syringes)	Safety box	Yellow
Infectious waste	Bag	Red
Medical waste	Bag	Yellow
General waste	Bag	Black

Transportation of Healthcare Waste

Open burning of Healthcare Waste

Treatment and Disposal

Most healthcare facilities have a contract with the District Upgrading Service for waste collection through which general wastes are usually transported to the disposal site. Currently, no special treatment facilities have been established for the management of healthcare wastes at the biggest hospitals of Ulaanbaatar. Since no adequate waste treatment facilities are available in most of the state and private hospitals, some portion of the healthcare waste is collected and transported separately to the disposal site, while the remaining is collected and transported along with the domestic waste. The data derived from the City Health Department (2005) show that 11.5% of healthcare facilities have on-site, low temperature, small-scale incinerators, 79.4% of healthcare facilities have contracts with these service providers and 9.1% open burn or send the waste to the disposal sites. A few facilities use autoclaves to treat infectious wastes. Figure below shows a makeshift incinerator for healthcare waste treatment and Figure top right shows open burning of healthcare waste. The Table shows various healthcare waste disposal methods adopted by the surveyed Soum hospitals.

Healthcare Waste Disposal Methods

Disposal method	Number of hospitals	Percent (%)
Combustion	77	74.8
Burial	1	1.0
Disinfection	1	1.0
Combination of combustion and burying	19	18.4
Combination of combustion and disinfection	2	1.9
Mixed	3	2.9

According to the survey on HCWM in 220 Soums, it can be noted that the total expenditure for collection and disposal of waste from soum hospitals is about USD 36/ tonne (42230 MNT).

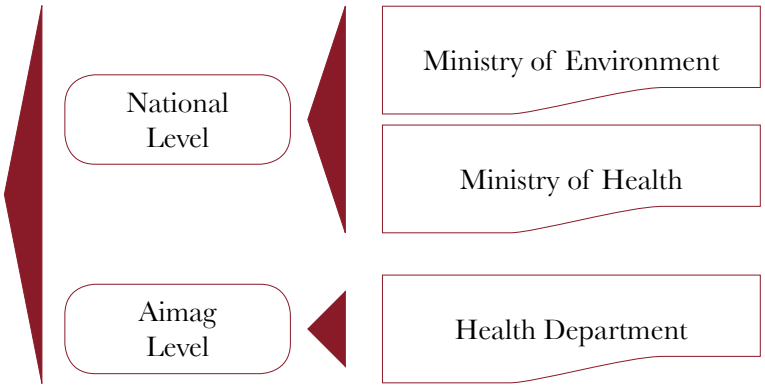
Makeshift Incinerator for healthcare waste in Village (Soum) Hospital

MONGOLIA

INSTITUTIONAL ANALYSIS

The Health Department in each Aimag is responsible for medical waste management from the healthcare facilities. At the national level, the Ministry of Environment (MoE) and MoH are responsible for healthcare waste management while at the Aimag health centers, epidemiologists are responsible. There are no special officers responsible for healthcare waste management at the local level. Every healthcare facility has a team or a responsible officer for special healthcare waste management. Figure below shows institutional setup governing healthcare waste management in Mongolia.

Institutional Setup Governing Healthcare Waste Managment



POLICIES AND LEGISLATION

The National Action Plan on Improvement of Solid Waste Management (2002), the law on Municipal and Industrial Waste (2004) and the regulation on Removal and Disposal of Hazardous Waste (2002) were approved by the Government of Mongolia and are being implemented. The Regulation for Improvement of Healthcare Waste Management and the regulation for Chemical Waste Management (2003) were approved through joint order issued by both the MoH and the MoE. Technical support was provided by WHO for the Regulation for Improvement of Healthcare Waste Management. Management. MoH is developing a national Action Plan on HWCM with WHO support.

The Health Sector Master Plan (HSMP) for developing the sector and improving the health of Mongolians was approved by the Government Resolution 72 in April 2005. Following the development of the HSMP 2006-2015, it became clear that an intermediate step was necessary if the implementers were to be able to use the HSMP and its strategic actions in the development of their operational plans. It also became evident that much more focus would be needed to move from the broad strategies listed in the HSMP to their actual implementation. Hence, the development of an Implementation Framework became inevitable. Improvement of healthcare waste management and proper disposal of expired drugs are included in the strategic actions of HSMP and identified as an issue of high priority for resource allocation and international support.

The Health Sector Master Plan Implementation Framework to implement HSMP as a midterm planning document was endorsed in February 2007 by Resolution 43 of the Ministry of Health. The Implementation Framework is, therefore the key instrument providing a 5-year, (2006-2010) activity framework, which will be used by all facilities and institutions to develop their business and annual operational plans. It unpacks the strategic actions in the HSMP, extracting and organizing the objectives and main activities along with their outputs and indicators. The Implementation Framework will primarily be used during the planning cycle. The Implementation Framework will also play a critical role in providing a sectoral orientation to the annual planning exercise in guiding the development of a sectoral management framework for setting up a solid waste management action plan and in building institutional and staff capacity in planning, management and monitoring. The Implementation Framework of HSMP identified strategic action to improve the management of healthcare waste and disposal of expired drugs sector wide.

The National Environmental Health Action Program (NEHAP) was endorsed by the Government in December 2005. One of the main objectives of this program is to take measures to decrease environmental contamination, maintain ecological balance, and decrease diseases caused by negative environmental factors. It focuses on improving solid and liquid wastes management and establishing a special facility for the disposal of healthcare waste in Ulaanbaatar. Table shows policies and legislation for HCWM in Mongolia.

INTERNATIONAL AND NATIONAL INITIATIVES

Mongolia has received substantial support from WHO through its Western Pacific Regional Office for various issues related to solid waste management including municipal and medical wastes. The following activities were done in Mongolia with WHO technical support:

- National assessment of healthcare waste management in Mongolia, 2007
- Global Alliance for Vaccines and Immunization-WHO funded project - National and regional level workshops, 2006
- Healthcare waste characterization study in Ulaanbaatar, 2005
- Municipal household waste characterization study in Ulaanbaatar, 2004

Policies and Legislation Governing Healthcare Waste in Mongolia

Type of waste	Policies/Legislation
Solid waste	The National Action Plan on Improvement of Solid Waste Management (2002)
Hazardous waste	The Regulation on Removal and Disposal of Hazardous Waste (2002)
Healthcare waste	The Regulation for Improvement of Healthcare Waste Management (2003)
Municipal and Industrial waste	The Law on Municipal and Industrial Waste (2004)
Chemical waste	The Regulation for Chemical Waste Management

Capital
Rangoon (Yangon)

Area
678,500 km²

Population
47.7 million

Population growth rate
0.8%

GDP - per capita (PPP)
$1,200

GDP - real growth rate
0.9%

(Source: CIA World Fact Book, 2008)

Myanmar is the largest country by geographical area in mainland Southeast Asia. The country is bordered by the People's Republic of China on the northeast, Laos on the east, Thailand on the southeast, Bangladesh on the west, India on the northwest, the Bay of Bengal to the southwest with the Gulf of Martaban and Andaman Sea defining its southern periphery. Myanmar is administratively divided into seven divisions and seven states.

HEALTHCARE FACILITIES

Healthcare facilities in Myanmar are divided into Government Hospitals, Rural Health Centers, Primary and Secondary Health Centers, Maternal and Child Health Centers and Private Clinics. Bed strengths in the hospitals for Yangoon vary between 16 and 1,500. The largest government and private hospitals are located in the urban areas of which some offer specialized services. According to the statistics from the Ministry of Health in 1994, the total number of available beds is 183 for a 100,000 population and the daily use of beds is 118 for 100,000 people. Inpatients account for about 50 for every 1,000 people and outpatient at 170. Table below presents information on the healthcare facilities in Myanmar.

Healthcare Facilities in Myanmar

Type of healthcare facilities	Number of healthcare facilities
Government Hospital	826
Rural Health Center	1,456
Primary and Secondary Health Center	86
Maternal and Child Health Center	348
Private Clinics	1,366

[6] *Healthcare Waste in Myanmar: A Status Report, submitted by Mr. Tin Aung Kyaw, Head of Branch, National Commission for Environmental Affairs, Ministry of Forestry, Nay Pyi Taw, Myanmar to the Thematic Working Group on Solid and Hazardous Waste*

MYANMAR[8]

MANAGEMENT OF HEALTHCARE WASTE

Healthcare wastes are unique forms of solid and liquid wastes generated in the diagnosis, treatment, prevention or research, of human and animal disease. Every year large amounts of hazardous wastes are produced by hospitals, clinics, dispensaries, private medical and dental clinics research and veterinary facilities. Healthcare waste in Myanmar is classified as: general (non-hazardous) wastes, infectious (non-sharp) wastes, sharps, clinical and pharmaceutical wastes, and hazardous wastes, such as, cytotoxic drugs, radioactive substances, and pressurized containers as shown in Figure below.

Classification of Healthcare Waste

A study conducted in Yangon City on the solid waste generation, collection and disposal by Yangon City Development Council (YCDC) has revealed that the healthcare waste forms about 8% of the total waste. Based on informal interviews with the staff and site visits of the consultants and professionals, it is noted that the total generation rate of solid waste in Yangon is about 2,200 ton/day of which healthcare waste may be about 176 tons/day (YCDC, 2001).

Waste generated from hospitals includes both liquid and solid wastes. The liquid waste contains specimen of blood, pus, sputum, urine, stool, biopsy material and other body fluids. The solid waste contains plastic, glass, organics, dressings, cotton, wrapping, empty glass vials etc. Ironically, the general waste also includes disposable syringes, intravenous drip sets, catheter, connectors, infusion tubes, plastic accessories, urine bags, blood bags, organic waste, and paper waste etc. The non-recyclable waste includes infected dressings, blood/pus stained dressings, laundry waste, and amputations etc.

The current situation of healthcare waste management system in Yangoon General Hospital was established in 1899, over 100 years back. The General Administrative Department of Yangon General Hospital has to deal with healthcare waste generated by each ward. Nearly 0.66 tons of both infectious and non-infectious wastes are collected every day of which infectious waste is about 0.44 tons and is incinerated. Sharps waste accounts for 0.22 tons and is mostly dumped or deep buried.

Collection, Storage and Transportation

Hospitals in Yangon City separate hazardous wastes (such as sharp wastes, infectious wastes) and general wastes. The collection system is operated in three shifts at 6 am, noon and 6 pm daily. General wastes in most hospitals are collected in plastic containers within the departments. Most of the collection is done by workers manually. In some hospitals, nurses and workers collect syringes, and other plastic materials after using and sell them for recycling. On the other hand, in some other, the workers separate needles from syringes and dispose the needles to the infectious waste container with other sharps wastes such as broken glasses. There is no separate container for sharps wastes and infectious waste. Some hospitals separate sharp wastes (needles) from syringes and dispose them in transparent plastic bottle, but without any label. Finally they are disposed along with the infectious waste. Normally, wastes from hospitals are collected in plastic containers. Green, red and yellow colors are used for color-coding as presented in Table below.

Containers and tanks are used for storing and transporting healthcare waste in Yangon. There are no standardized storage containers. Container sizes vary between hospitals. Most hospitals in Yangon City area store all wastes from the hospital in separate brick storage tanks within the hospital campus before collection. The tanks are generally not protected against sunlight and rain.

YCDC is responsible for waste collection from the temporary waste storage bin of the hospitals and transport them to disposal sites.

Treatment and Disposal

General waste from hospitals is sent to the open dump by YCDC. All infectious wastes are burnt in the cemetery incinerator. After incineration, the ashes are sent to the open dump sites for disposal. However, there is no proper treatment for recyclable materials. The recyclers wash all recyclable materials from hospital wastes and mix with other recyclable wastes. Clinical waste incinerated at cemeteries in Yangon is 171.54 tons/year and 51.18 tons/year of sharps are buried at the sharp pits near the cemeteries.

Colour Code for Healthcare Waste Collection

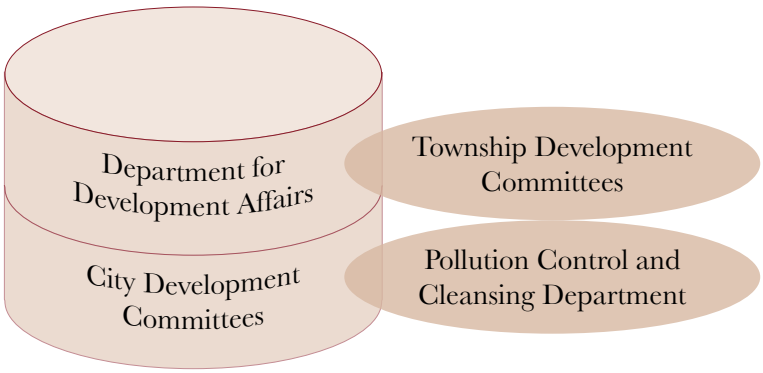
Type of waste	Disposal	Colour
Sharp edges, glass, etc	Deep burial	Red
Infectious parts	Incineration	Yellow
Domestic/General waste	Dump site	Black

INSTITUTIONAL ANALYSIS

The Government of the Union of Myanmar formed the National Commission for Environmental Affairs (NCEA) in February 1990. The NCEA was established to act as a focal point and coordinating body for environmental affairs and to promote environmentally sound and sustainable development.

Waste collection and disposal in Myanmar has been the responsibility of local municipal authorities, without any private sector involvement. In Yangon (lower Myanmar) and Mandalay (upper Myanmar), autonomous City Development Committees and their Pollution Control and Cleansing Departments (PCCDs) with a network of branches and sub-units are tasked with solid waste management within their municipal areas. In other parts of the country, Township Development Committees under the Department for Development Affairs (DDA), Ministry of Progress of Border Area Development and National Races and Development Affairs (MPBND), manage municipal waste collection and disposal. Figure below shows the institutional setup governing healthcare waste in Myanmar.

Institutional Setup Governing Healthcare Waste Management



POLICIES AND LEGISLATION

Environmental management in Myanmar is largely sectoral with policies and regulations being formulated and administered by the concerned ministries and departments. At present, there are 58 legal instruments in Myanmar that can be considered to address environmental issues. However, some of them were enacted before independence and were prevention-oriented with less emphasis on conservation and sustainable use. But, the more recent policies and laws enacted by a number of ministries constitute many elements or provisions that are directly related to environmental conservation and protection. These laws and regulations call for prohibition and prevention of environmental degradation.

The National Commission for Environmental Affairs is the main institution in Myanmar with the responsibility for the overall environmental management in the country. The Government gives priority to conserving the environment and preventing its degradation. The National Environment Policy of Myanmar was adopted in December 1994.

In order to assist the Commission in carrying out its mandate the following four specialized committee were also formed.

- Committee on Conservation of Natural Resources
- Committee on Control of Pollution
- Committee on Research, Education and Information
- Committee on International Cooperation

With a view to implement the National Environmental Policy of Myanmar, the Myanmar Agenda 21 was formulated in June 1997. Myanmar Agenda 21 aims at strengthening and promoting systematic environmental management in the country.

According to Myanmar Agenda-21, pollution control and cleansing rules have been drawn up by the YCDC and entered into effect on 24 December 1999. In Pollution Control and Cleansing Rule, there are 27 sections in cooperation and coordination with other governmental agencies, identifying and controlling the disposal of chemicals, toxic materials and radioactive substances.
At present, PCCD has prepared the bye-law on pollution control comprising the important section concerning waste management, such as collection, transportation, treatment and disposal of industrial and domestic waste. In addition prevention of waste pollution due to improper disposal of industrial waste and prohibition of storage or transportation of toxic substances are also addressed.

NCEA has drafted the Union of Myanmar Environmental Protection Law and is awaiting Government's approval.

Myanmar is now a party to several international and regional conventions and agreements relating to the environment as well as to other which may have some impact on the environment. Action plans have been prepared for the implementation of these "conventions and agreements".

INTERNATIONAL AND NATIONAL INITIATIVES

Chemical Toxicology Research Division, Department of Medical Research (Lower Myanmar), Ministry of Health will be the starting and leading unit to carry out national surveys to provide necessary data for healthcare waste management in Myanmar.

"Hospital Waste Management and Air Pollution emitted from Waste Incineration in Yangon City" is being started with the small grant of WHO after the approval of ethical committee. This study will provide the data regarding the current situation of healthcare waste management system in Yangon General Hospital in terms of quality and quantity of waste.

In order to implement the study on healthcare waste management system successfully and completely, funding, technical and material supports are major gaps.

A research grant from Alliance for Health Policy and Systems Research (Supporting National Processes for Evidence-informed Policy in the Health Sector of Developing Countries) had been applied. This research grant will be jointly implemented by Department of Medical Research (Lower Myanmar) (DMR-LM) and Department of Health (DoH) along with the international expert's opinions. This research grant "Promotion of healthcare waste management: Guidelines for improved, user-friendly and sustainable system in hospitals of Myanmar" can improve healthcare waste management system by implementing improved guidelines and the best available technology using the integrated waste management approach.

Capital
Manila

Area
300,000 km²

Population
96 million

Population growth rate
1.991%

GDP - per capita (PPP)
$3,400

GDP - real growth rate
4.5%

(Source: CIA World Fact Book, 2008)

Philippines is an archipelagic country located in Southeast Asia with Manila as its capital city. The archipelago comprises of over 7,000 islands in the Western Pacific Ocean, sharing maritime borders with Indonesia, Malaysia, Palau, the Republic of China (Taiwan), and Vietnam. Approximately 1,000 of its islands are inhabited. The nation is divided into eighty-one provinces further subdivided into cities and municipalities.

HEALTHCARE FACILITIES

A survey conducted in 2003 by the Environmental Management Bureau, Department of Environment and Natural Resources (DENR) indicates that there are about 1,719 hospitals and medical centers nationwide majority of which are located in the national capital region. Of these, only 227 are registered with the Environmental Management Bureau (EMB) as Hazardous Waste Generators in compliance with the Republic Act (RA) 6969: Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990. However, the most recent data (2007) reveals that there 1,952 healthcare facilities (medical centers, hospitals and clinics) registered as Hazardous Waste Generators nationwide. This is about 21% of the total registered Hazardous Waste Generators including among other major industries and environmental laboratories.

Healthcare Facilities in the Philippines

Healthcare facilities	Number of healthcare facilities (2003)	Number of healthcare facilities (2007)
DENR-EMB		
Registered	227	1952
Unregistered	1492	
DoH		
Registered		70

[9] *Healthcare Waste in Philippines: A Status Report, submitted by Mr. Geri Geronimo Sanez, Chief, Hazardous Waste Management Section, Department of Environment and Natural Resources, Quezon City, Philippines to the Thematic Working Group on Solid and Hazardous Waste*

PHILIPPINES[9]

There were about 70 hospitals, medical centres and reference laboratories across the country in 2007 under the Department of Health (DoH) of which 21 are located in Metro Manila. The Table on the left shows the distribution of healthcare facilities under DENR-EMB and DoH. The Table on the right shows the regional distribution of unregistered hospitals as hazardous waste generators in 2003.

Hospitals and healthcare facilities are classified by the DOH based on the scale and level of services offered. Government hospitals and healthcare facilities are operated and maintained partially or wholly by the national, provincial, city or municipal, other political unit, or by any department, division, board or agency while the private is established and operated with funds through donation, principal, investment, or other means, by any individual, corporation, association or organization.

General hospitals or medical centres provide services for all types of deformity, disease, illness or injury while special hospitals and other healthcare facilities are primarily engaged in the provision of specific clinical care and management.

Regional Distribution of Hazardous Waste Generators

Region	Registered Hospitals	Unregistered Hospitals
Region 1	2	119
Region 2	2	80
Region 3	3	187
Region 4A	8	215
Region 4B	2	49
Region 5	12	109
Region 6	13	59
Region 7	7	99
Region 8	1	75
Region 9	1	64
Region 10	18	77
Region 11	35	76
Region 12	9	86
Region 13	8	52
NCR	98	85
CAR	8	42
ARMM	0	18

NCR: National Capital Region
CAR: Cordillera Administrative Region
ARMM: Autonomous Region in Muslim Mindanao

MANAGEMENT OF HEALTHCARE WASTE

According to the Joint Administrative Order (JAO) 2005-02, healthcare wastes include all wastes generated as a result of the following:

- Diagnosis, treatment, management and immunization of humans or animals
- Research pertaining to the above activities
- Producing or testing of biological products
- Waste originating from minor or scattered sources (i.e. dental clinics, alternative medicine clinics, etc.)

Healthcare wastes are categorized under miscellaneous wastes pathogenic or infectious wastes and pharmaceuticals and drug wastes, according to the Department Administrative Order (DAO)2004-36. As per this order, pathological wastes includes tissues, organs, fetuses, bloods and body fluids, infectious wastes and sharps while pharmaceuticals wastes includes expired pharmaceuticals and drugs stocked at producers and retailers' facilities. Although other hazardous wastes such as friable asbestos waste, pesticides and Persistent Organic Pollutants (POPs) are classified under miscellaneous waste in the Department Administrative Order 2004-36, the major portion of the waste belongs to pathological and pharmaceutical wastes. The Figure presents a typical classification of healthcare waste in the Philippines. The composition and characteristics of healthcare wastes are in conformance with the classification of hazardous wastes.

Classification of Healthcare Waste

Annual Profile of Hazardous and Healthcare Wastes

Hazardous Healthcare Wastes	Quantity (tons/year) 2005	Quantity (tons/year) 2006	Quantity (tons/year) 2007
Miscellaneous Waste	798,033	912,724	1,945
Wastes Treated	797,495	906,908	1,866
Wastes Disposed	797,565	886,571	1,119
Wastes Stored	475	26,425	2,879

Note: A significant variation in the quantities is observed between the years due to inconsistency in reporting. Data for 2007 is for the first 3 quarters.

Table above shows a profile of the three year reported data on generated, treated, disposed and stored healthcare wastes in the Philippines. These data are reported by the registered hazardous waste generators to the Environmental Management Bureau in compliance with the RA 6969 implementing rules and regulations.

Collection, Storage and Transportation

Healthcare waste is segregated at the source by sorting them into color coded plastic bags or containers. These wastes are to be placed in clearly marked containers that are appropriately labeled for the type and weight of the waste. Except for sharps and fluids, other wastes are generally collected in plastic bags, plastic lined cardboard boxes or leak proof containers that meet specific performance standards. Sharps are to be collected in puncture proof containers (usually made of metal or high density plastic) and fitted with covers. Bags and containers for infectious waste are to be marked with the international infectious substance symbol. The color coding scheme for containers is shown in Table below.

Color code Used for Healthcare Waste

Type of waste	Storage	Color Code
Non-infectious dry waste	Plastic bag or containers	Black
Non-infectious wet waste	Plastic bag or containers	Green
Infectious, pathological & pharmaceutical waste	Plastic bag or containers	Yellow
Sharps & pressurized containers	Puncture proof containers	Red
Genotoxic & radioactive waste	Plastic bag or containers	Orange
Chemical waste including those with heavy metals	Chemical resistant containers	Yellow with black band

All healthcare waste is to be collected and stored in designated areas until they are transported to designated off-site treatment facilities. The storage area is to be marked with appropriate warning signs. Transportation of waste within the establishment is done using dedicated wheeled trolleys, containers or carts.

Collection and transportation of these wastes are regulated and requires the registration of waste transporter with the EMB to obtain the required permit, including the submission of the manifest for each transport. A refrigerated or closed van is required for the transport of healthcare waste. Permit to transport is only issued to a registered transporter holding a service agreement with a registered treatment, storage and disposal facility. As of February 2008, there are 61 registered hazardous waste transporters eligible of transporting healthcare waste as stipulated in the Hazardous Wastes Tracking System and most of these operate or service the NCR and Region 4A (Calabarzon) in the Philippines.

Treatment and Disposal

Since the implementation of the Philippine Clean Air Act of 1999 (RA 8749), incineration has been banned in Philippines and only non-burn technologies are allowed to be used for the treatment and disposal of healthcare and hazardous wastes. Non-burn technologies include thermal treatment such as pyrolysis, autoclave, hydroclave, microwave and sterilization. As on February 2008, about 24 treatment, storage and disposal facilities using non-burn technologies as well as encapsulation and solidification for treatment of healthcare wastes and expired pharmaceuticals and drugs were registered. Final disposal of the treated healthcare wastes and residues are in specific cells in authorized landfill.

The Joint Administrative Order sets specific criteria, standards and guidelines on:

- Handling, collection, storage and transport of healthcare waste
- Treatment (thermal, chemical, irradiation, biological process, encapsulation and inertization)
- Final waste disposal system and facilities (controlled dump facility, sanitary landfill facility, safe burial on healthcare facility premises, sharps and syringe disposal through concrete vault)

INSTITUTIONAL ANALYSIS

The Joint Administrative Order is to be implemented by the DENR through EMB and its Regional Offices, the National Solid Waste Management Commission (NSWMC) and by the DoH through the Center for Health Development (CHD), Bureau of Health Facilities and Services (BHFS), Bureau of Health Devices and Technology (BHDT), the National Center for Disease Prevention and Control (NCDPC), the National Center for Health Facility Development (NCHFD), and the National Reference Laboratory (NRL)-East Avenue Medical Center in Quezon City.

The EMB-Central Office and EMB- Regional Office are the responsible and primary regulatory agency for healthcare waste management in the Philippines. The EMB is tasked to enforce the requirements and procedures including the permitting system on healthcare waste management. Registration of healthcare facilities as Hazardous Waste Generators and the processing and approval of permits for transporting waste are done at the EMB-Regional Offices.

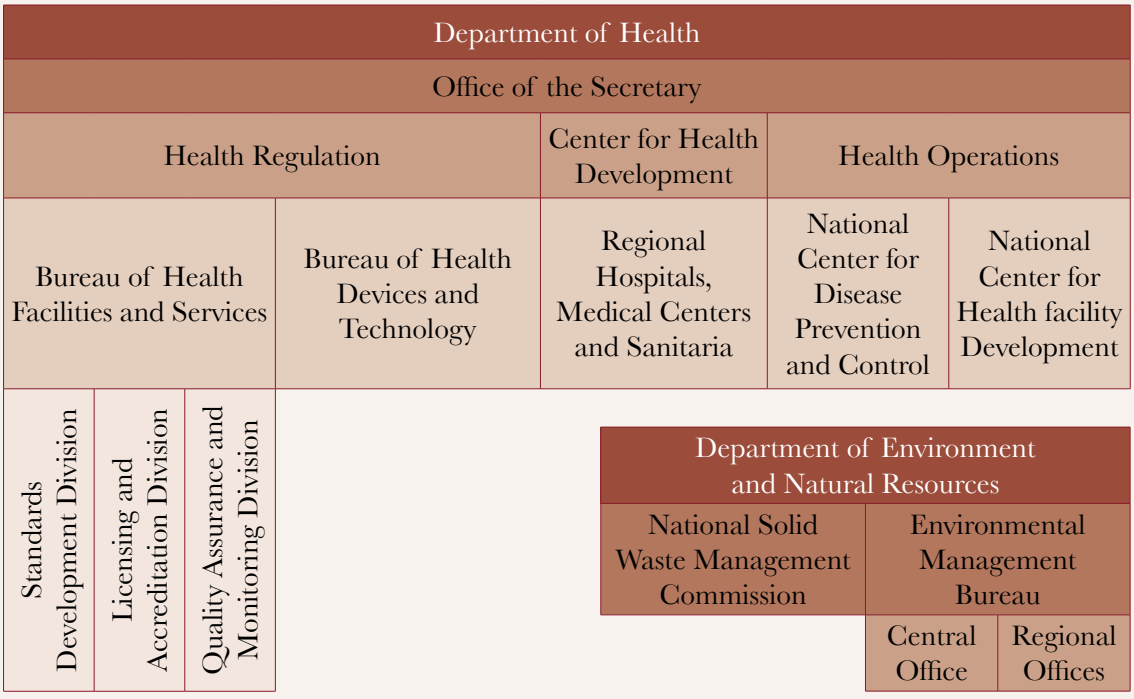
The EMB-Central Office is tasked to evaluate and approve applications for the registration of hazardous waste transporter with specific handling capability and the required type of conveyance. The EMB- Central Office is responsible for the registration of treatment, storage and disposal facilities with appropriate treatment and disposal technology for the healthcare wastes. The Hazardous Wastes Tracking System database established and operated at the EMB-Central Office, is updated regularly to further capacitate it in extracting data and information specific to the waste class of interest, quantities generated, and the treatment and disposal method employed. The Hazardous Wastes Tracking System also hosts the data on the registered hazardous wastes transporters and treatment, storage and disposal facilities in the Philippines.

Licensing and issuance of permit to operate healthcare facilities such as hospitals, medical centers, clinics, etc., is the responsibility and mandate of the Bureau of Health Facilities and Services of the DoH. According to the Philippines DoH, healthcare facilities and services are being regulated by its Bureau of Health Facilities and Services in coordination with CHDs.

The Bureau of Health Devices and Technology of the DoH, on the other hand, develops plans, policies, national objectives, programs, projects and strategies for regulating health technologies, medical and health devices and facilities and other health-related devices that may pose hazards to human health. DoH requires all healthcare waste treatment, storage and disposal facilities facility operators and hazardous waste generators with on-site waste treatment facilities to use DoH- Bureau of Health Devices and Technology registered equipment or devices for the treatment of healthcare wastes.

The DoH strives to ensure compliance of all environmental requirements and is responsible to notify the DENR on actions taken on cases of non-compliance or notice of violation issued to healthcare facilities, institutions and business establishments. The institutional setup governing healthcare waste in Philippines is presented in Figure below.

Institutional Setup Governing Healthcare Waste Management



POLICIES AND LEGISLATION

RA 6969: "Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990", is at present, the only legislation in the Philippines that regulates healthcare waste. The implementing rules and regulations, under the Department Administrative Order (DAO) 2004-36, classifies healthcare waste under Miscellaneous Waste with waste number M501 assigned to pathological wastes (tissues, organs foetuses, bloods and body fluids), infectious wastes and sharps and waste number M503 assigned to expired pharmaceutical and drugs.

RA 8749: "The Philippine Clean Air Act of 1999" under the DAO 2000-81, allows only non-burn technologies to be used in the destruction, treatment and disposal of healthcare and hazardous wastes. The allowed non-burn technologies are to comply with the criteria and emission standards on non-burn technologies provided in Rule 28 of DAO 2000-81. Non-burn technologies include thermal treatment i.e., pyrolysis, autoclave, hydroclave, microwave and sterilization. Section 20 of RA8749 provides the regulatory "Ban on Incineration" of municipal, healthcare and hazardous wastes.

In an effort to strengthen and streamline policies, rules and regulations on healthcare waste management, the JAO 2005-02, "Policies and Guidelines on Effective and Proper Handling, Collection, Transport, Treatment, Storage and Disposal of Healthcare Wastes" was issued by the DENR and DoH on 24 August 2005. The objectives of the JAO 2005-02 are to provide guidelines to generators, transporters and owners or operators of treatment, storage, disposal (TSD) facilities on proper HCWM. It clarifies the jurisdiction, authority and responsibilities of the DENR and DoH and harmonizes the efforts of the DENR and DoH on proper healthcare waste management. The JAO is issued pursuant to the following laws, rules and regulations:

- Clean Air Act of 1999 (RA 8749)
- Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990 (RA 6969)
- Ecological Solid Waste Management Act of 2000 (RA 9003)
- Refuse Disposal of the Sanitation Code of the Philippines [Chapter XVIII, Implementing Rules and Regulations, Presidential Decree 856]
- Clean Water Act of 2004 (RA 9275)
- Environmental Impact Statement (EIS) System (PD 1586)
- Hospital Licensure Act (RA 4226)

Capital
Singapore

Area
692.7 km²

Population
4.6 million

Population growth rate
1.135%

GDP - per capita (PPP)
$52,900

GDP - real growth rate
3%

(Source: CIA World Fact Book, 2008)

Singapore an island country located at the southern tip of the Malay Peninsula. Singapore is one of the four remaining true city-states in the world and is the smallest nation in Southeast Asia. Singapore is one of the most densely populated nations in the world with about 6,650 people/km2.

HEALTHCARE FACILITIES

Singapore healthcare system consists of both public and private institutions. Public healthcare facilities in Singapore fall under two vertically integrated delivery networks, the National Healthcare Group (NHG) and the Singapore Health Services (SingHealth). These two networks minimize duplication of services, and enable affordable quality healthcare services to its citizens as shown below:

Healthcare Facilities in Singapore

Types of Healthcare Facilities	Number of Facilities
1.Public Sector (National Healthcare Group & Singapore Health Services)	270
- Hospital/Specialty Centres	13
Hospital	7
Specialty Centres	6
Total Number of Beds	8,338
- Primary Healthcare: Polyclinic	18
- Dental Clinics	240
2. Private Sector	
- Hospital/Specialty Centres	16
Total Number of Beds	3,207
- Primary Healthcare :Clinics	2000 approx

(Source: MoH, 2006)

Primary Healthcare: This includes preventive healthcare and health education. Private clinics provide 80% of the primary healthcare services while government polyclinics provide the remaining. There are 18 outpatient polyclinics (nine managed by NHG and nine by SingHealth) and some 2,000 private medical practitioner's clinics providing primary healthcare services. These polyclinics provide outpatient medical care, follow-up of patients discharged from hospitals, immunization, health screening and education, investigative facilities and pharmacy services at subsidized rate.

[10] *Healthcare Waste in Singapore: A Status Report, submitted by Mr. Desmond Tan Kek Chon, Executive Engineer, Resource Conservation Department, The National Environment Agency, Singapore to the Thematic Working Group on Solid and Hazardous Waste*

SINGAPORE[10]

Hospital Care: Singapore has 29 hospitals and speciality centres of which 13 belong to the public sector and 16 to the private sector. There are seven public hospitals and six national speciality centres in the public sector. The seven public hospitals comprise of five general hospitals, a women's and children's hospital and a psychiatry hospital. The general hospitals provide multi-disciplinary acute inpatient and specialist outpatient services and a 24-hour emergency department. The national specialty centres provide specialty treatment for cancer, cardiac, eye, skin, neuroscience and dental care.

Intermediate and Long Term Care: These are residential and community-based healthcare services that cater to the long-term needs of the Singaporeans. The services include community hospitals, chronic sick hospitals, nursing homes, sheltered homes for the ex-mentally ill, inpatient hospice institutions, home medical, home nursing and home hospice care services, day rehabilitation centres, dementia day care centres, psychiatric day care centres and psychiatric rehabilitation homes.

Dental services: This includes dental care beginning with preventive dentistry promoted through the Health Promotion Board. Public dental services are available in some polyclinics and hospitals, and the National Dental Centre. There are 240 public dental clinics in Singapore.

The 13 hospitals and specialty centres under the public sector have been restructured by the government to be run as private companies wholly-owned by the government in order to have management autonomy and flexibility to respond more promptly to the needs of the patients. The restructured hospitals are different from the other private hospitals in that they receive an annual government subsidy for the provision of subsidized medical services to the patients.

In 2006, there were a total of about 11,545 hospital beds in the 29 hospitals and specialty centres in Singapore, at a ratio of 2.6 beds per 1,000 total populations. About 72% of the beds are in the 13 public hospitals and specialty centres with bed capacity between 185 to 2,064 beds. The 16 private hospitals have a bed capacity varying from 20 to 505 beds. The Table on the left details the healthcare facilities in Singapore.

MANAGEMENT OF HEALTHCARE WASTE

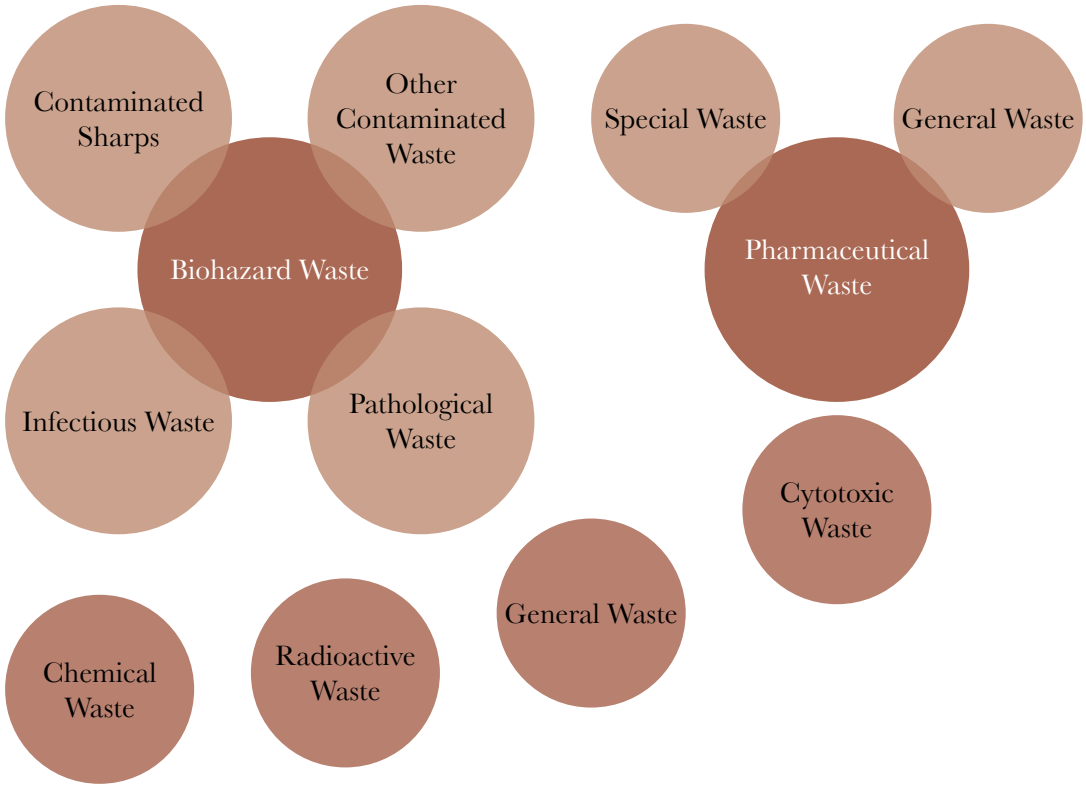
Hospital wastes in Singapore are classified into infectious waste, pathological waste, contaminated sharps, routine clinical waste, cytotoxic waste, radioactive waste, pharmaceutical waste, chemical waste and general waste. Figure below presents the classification of healthcare waste.

Infectious waste arises from patients with infectious diseases such as AIDS, Ebola-Marburg virus disease and Lassa fever and also includes cultures and stocks of infectious agents from laboratory work. Infectious waste, pathological waste, contaminated sharps and other contaminated waste from treatment areas are considered as biohazardous wastes necessitating special handling and disposal. Infectious waste, in addition, needs pretreatment before disposal as biohazardous waste.

Pathogenic waste from hospitals is classified under toxic industrial waste. The total amount of pathogenic wastes generated in 2006 is approximately 1.4 million litres.

Radioactive waste includes those contaminated with radionuclide from nuclear medicine, radio-immunoassay and bacteriological procedures.

Classification of Healthcare Waste



Containers for collecting Sharp Waste

Pharmaceutical wastes are further classified into general pharmaceutical waste such as vitamin tablets, paracetamol tablets, creams and ointments etc, and special pharmaceutical waste such as antibiotics, vaccines, other immunological products, and controlled drugs such as cocaine. Only special pharmaceutical waste needs special disposal by incineration. General pharmaceutical waste can be disposed of as general refuse.

Chemical wastes include discarded solid, liquid and gaseous chemicals from diagnostic and experimental work and cleaning, housekeeping disinfecting and engineering services such as used lubricating oil, spent photographic developing solutions and spent solvents. These wastes are classified under toxic industrial waste and are to be segregated for special disposal by licensed toxic waste contractors.

General wastes include office waste, food waste, packing materials, wastewater from laundries and floor washing and other substances that do not pose any significant contamination risk in handling. General wastes are disposed as general household waste by contractors at public waste disposal facilities such as refuse incineration plants and sanitary landfill.

Collection, Storage and Transportation

Biohazardous wastes are segregated and collected in small color-coded disposal bags at the point of generation in the hospital. These bags are then transferred to larger color-coded disposal bags placed at the initial storage area of the utility / disposal rooms of the wards. These large disposal bags are to be clearly marked with the hospital name and the internationally recognized symbol for biohazard, radioactive and cytotoxic materials.

The standard color code used for waste segregation is:

- yellow bags for biohazardous wastes
- purple for cytotoxic
- red for radioactive wastes
- black for general waste

Used syringes with attached needles are collected in properly labeled puncture-proof plastic sharp container. When the container is full, it is securely closed and disposed in the large yellow bag provided at the utility / disposal room. The Figure above shows the containers used for collecting contaminated sharps.

Radioactive wastes are required to be stored until the radioactive level of the waste is low and safe before disposal at sanitary landfill.

Color Code Used for Healthcare Waste

Type of waste	Storage	Color Code
Biohazardous Waste	Plastic Bags	Yellow
Sharps	Puncture proof plastic container	Yellow
Cytotoxic Waste	Plastic Bags	Purple
Radioactive Waste	Plastic Bags	Red
General Waste	Plastic Bags	Black

The colour coding used in Singapore is shown in the Table above.

Color-coded disposal bags when filled with the waste are securely fastened and transported in designated trolleys to a final storage area. Separate final storage areas are provided for biohazardous and general waste. Designated bins, each of 240 litres capacity are provided with proper labeling to receive the biohazardous waste in color-coded bags, for storage and collection by licensed hospital waste contractors. The containers come with securely fitting lids and are suitable for transportation to off-site disposal facilities.

The final waste storage area for biohazardous waste is strictly maintained as prohibited area and no compaction machine is allowed in this area. For new hospitals to be built in Singapore, it is a requirement at the design stage to have the biohazardous waste storage area connected to the main buildings of the hospital. This is to avoid the need to transport the waste from the initial storage area across open area to the final waste storage area.

Treatment and Disposal

Hospitals are to treat the wastes generated in their approved waste treatment plant and dispose off the residues at any National Environment Agency (NEA) sanitary landfill site or engage a licensed toxic industrial waste collector for waste treatment and disposal. The toxic industrial waste collector receives toxic industrial wastes for storage, reprocessing, treatment and disposal. The waste collector is to obtain a license and confine his waste storage and treatment activities to approved premises and facilities.

Two licensed hospital waste disposal contractors, Cramoil Singapore Pte Ltd and SembCorp Environmental Management Pte Ltd provide services. They operate a fleet of seven totally enclosed trucks to provide collection and transportation of the biohazardous waste as shown in the Figure on the right. They have dedicated incinerators for the biohazardous and used cytotoxic wastes from the hospitals (Figure right bottom).

top and middle: Transportation of healthcare waste
bottom: Incinerator for Healthcare Waste

The incinerators are specially designed with secondary chamber operating at a minimum temperature of 1000°C with a minimum residence time of one second. Continuous monitoring and recording instruments are installed to maintain the conditions.

Movement of wastes is tracked by means of the consignment note system (e-Tracking) to prevent illegal dumping and disposal of toxic industrial wastes.

The hospitals maintain inventory records of the biohazardous waste received at the storage and those disposed through the licensed hospital waste contractors. When collecting the waste from the hospitals, the driver is to obtain the consignment note prepared by the hospital giving detailed quantity and time of collection. Hospitals and the licensed contractors are to forward a copy of the duly completed consignment note to the Pollution Control Department (PCD) of the NEA within three days of the transportation. Hospitals are to submit an annual notification form to inform PCD of the total quantity of biohazardous waste disposed during the year. Truck driver are to carry the Transport Approval issued to the licensed hospital waste contractors, and comply with the conditions stipulated in the approval such as the routes, the restricted hour for transportation, and to activate the emergency action plan in an event of accident or spill.

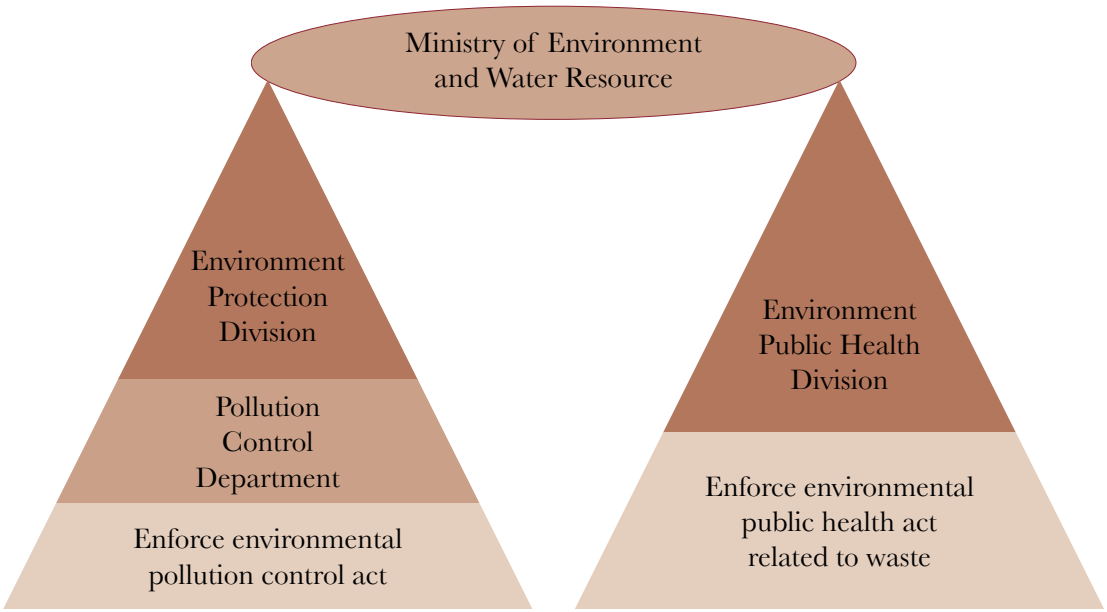
Radioactive wastes from hospitals are disposed at the sanitary landfill site operated by the NEA.

INSTITUTIONAL ANALYSIS

The Ministry of the Environment and Water Resources (MEWR) is responsible for enforcing the environmental pollution laws in Singapore. The NEA was formed under the Ministry of Environment in 2002 to implement environmental policies. The NEA is headed by a chief executive officer, and is comprised of five divisions: Environmental Protection, Environmental Public Health, Corporate Services, Meteorological Services and Human Resources. The PCD comes under the Environmental Protection Division and is responsible for enforcing the Environmental Pollution Control Act and its subsidiary laws. The PCD is responsible for toxic industrial waste control and ensures its safe handling, treatment and disposal. The Environmental Public Health Division administers the laws related to waste, contained in the Environmental Public Health Act and its subsidiary legislation.

All the hospitals in Singapore have appointed members of their management staff as waste managers responsible for the proper implementation of their hospital waste management programmes. In most cases, the housekeeping managers are appointed as waste managers. Each hospital has a waste management manual prepared in a standard format. These manuals provide written policies and procedures on waste handling, collection and disposal. It ensures that consistent procedures on waste handling and disposal are being practiced. The institutional setup governing healthcare waste in Singapore is shown in Figure below.

Institutional Setup Governing Healthcare Waste Management



POLICIES AND LEGISLATION

The collection, recycling, treatment and disposal of toxic industrial wastes are controlled under the Environmental Public Health Act (EPHA) and the Toxic Industrial Wastes Regulations (TIWR).

The EPHA controls waste including toxic, domestic and industrial waste.

The generation, collection, treatment, disposal and storage of toxic industrial wastes is regulated under the TIWR. Industrial wastes controlled under the TIWR are listed in the Schedule of the Regulations as waste streams from specific industrial activities, wastes with specified toxic components and as specific categories of wastes. The list includes spent acids, alkalis, and wastes containing gallium arsenide, spent etching solutions and pathogenic waste from hospitals.

According to the TIWR, the waste generator, collector, carrier or transporter and the truck driver are key persons involved in the control and management of toxic industrial waste. Written transport approval from PCD is required for the transportation of wastes in quantities which exceed those specified in the TIWR. Responsibilities of the key person in the transportation are as follows:

- Consignor is the person who presents a consignment of controlled wastes for transport. The consignor can be either the generator or the licensed collector and is responsible to obtain transport approval from PCD to transport the wastes;
- Carrier is the person who undertakes the transport of the controlled wastes. He can either be the generator, the licensed collector or the transport company engaged by one of them;
- Consignee is the person who receives the controlled wastes. He is usually the licensed collector;
- Driver is the person driving the vehicle transporting the toxic industrial wastes.

INTERNATIONAL AND NATIONAL INITIATIVES

The Waste Management and Recycling Association of Singapore (WMRAS) is an association which aims to professionalize and develop a leading waste management and recycling industry in Asia. It keeps the members of the association updated on the regulatory and policies developments, best practices in waste management through information exchange with the MEWR, NEA and other related organizations.

Capital
Bangkok

Area
514,000 km²

Population
65.5 million

Population growth rate
0.64%

GDP - per capita (PPP)
$8,700

GDP - real growth rate
4.8%

(Source: CIA World Fact Book, 2008)

Thailand a country in the heart of Southeast Asia, is bordered to the north by Laos and Burma, to the east by Laos and Cambodia, to the south by the Gulf of Thailand and Malaysia, and to the west by the Andaman Sea and Burma. The country is administratively divided into 75 provinces and two specially governed districts, Bangkok and Pattaya. Each province is further divided into districts and sub-districts.

HEALTHCARE FACILITIES

Healthcare facilities in Thailand consist of hospitals and small-scale facilities. There are approximately 39,000 healthcare facilities of which 1,457 are hospitals. Government-owned hospitals accounts for 68% of which approximately 90 % are under the Ministry of Public Health (MoPH) and the rest 10% (102 hospitals) are owned by other ministries such as Ministry of Education (MoE) and Ministry of Defense (MoD). Private-owned hospitals account for 32 %.

Small-scale healthcare facilities are 37,659 in total. About 73% (27,363 clinics) is private-owned, while government community healthcare centers are about 27 % (10,296). Table below shows the different types of healthcare facilities in Thailand.

Healthcare Facilities in Thailand

Types of Healthcare Facilities	Number of hospitals / clinics
Hospitals	1,457
Government-owned Private-owned	985 472
Small-scale Healthcare Facilities	37,659
Community Health Centers (Government-owned) Clinics (Private-owned)	10,296 27,363

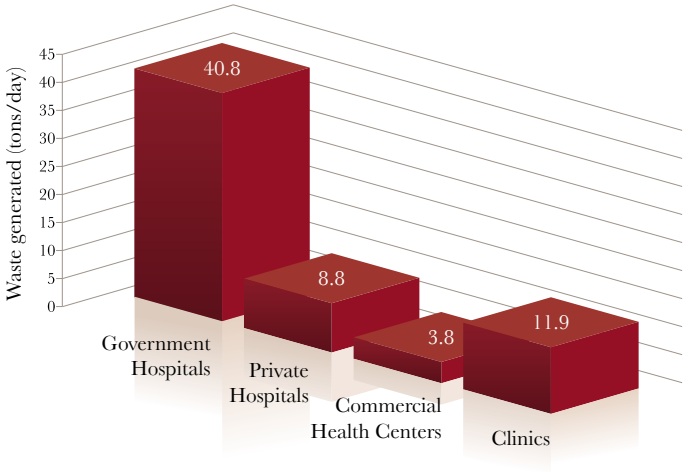
[11] *Healthcare Waste in Thailand: A Status Report, submitted by Ms. Sunee Piyapanpong, Director of Waste and Hazardous Substances Management Bureau, Ministry of Natural Resources and Environment, Bangkok, Thailand to the Thematic Working Group on Solid and Hazardous Waste*

THAILAND[11]

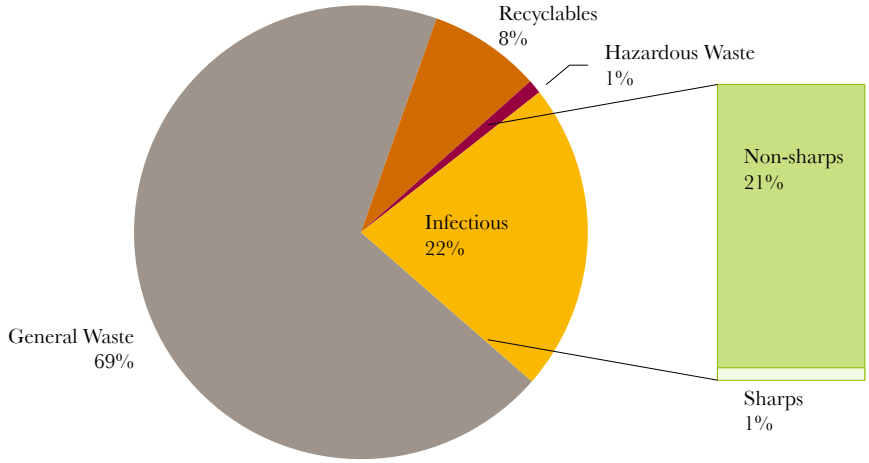
MANAGEMENT OF HEALTHCARE WASTE

Healthcare waste in Thailand comprises of infectious waste, hazardous waste, recycled waste and general waste. Infectious waste is further categorized into sharps and non-sharps. Sharps are about 1%, while non-sharps account for 21% (DoH, 1996). Figure below shows the composition of healthcare waste.

Infectious Waste Generation in the Healthcare Facilities



Composition of Healthcare Waste in State Service Hospital - Inpatient



The total amount of infectious waste generated from the healthcare facilities is approximately 65 tons/day or about 24,000 tons/year. Infectious waste generation at hospitals is approximately 49.7 tons/day while small-scale healthcare facilities generated 15.7 tons/day. Figure above shows the infectious waste generation from various healthcare facilities in Thailand.

Collection, Storage and Transportation

Waste from healthcare facilities are collected and segregated at the point of generation into different color coded containers based on the type of waste as shown in the Table. Collection and storage is the responsibility of the healthcare facility.

In the Bangkok Metropolitan area, the Bangkok Metropolitan Administration provides services for the collection, transport and disposal of healthcare wastes to both the public and private healthcare facilities. On an average, in 2005, BMA collected and transported 8.5 tons of healthcare wastes every day (0.11 kg/bed/day) from 582 hospitals, public health services centers and healthcare institutions. This is done using trucks of 4 m^3 capacity and controlled to a temperature below 15^{0}C.

Color Code Used for Healthcare Waste

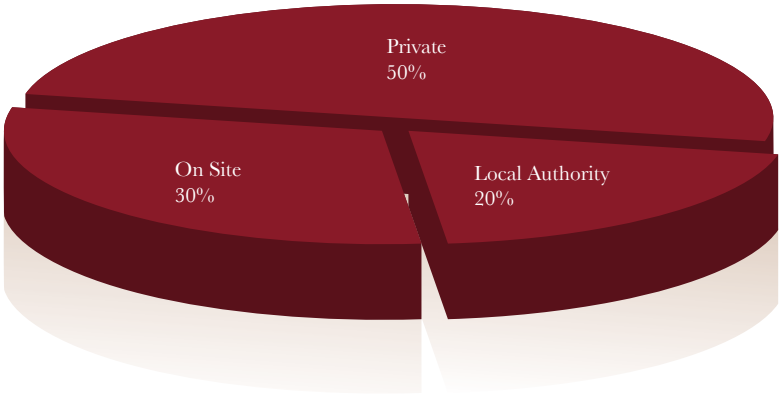
Type of waste	Storage	Color Code
Infectious Waste		
• Sharps	Bins	Red
• Non-Sharps	Plastic Bags	Red
Hazardous Waste		Yellow
General Waste	Plastic Bags	Black

Treatment and Disposal

Incineration is the most common treatment method used in Thailand. The Bangkok Metropolitan Administration operates two incinerators of capacity 10 tons/day for the disposal of healthcare wastes in the Bangkok area. As of 2005, the MoPH had installed incinerators at all large hospitals, covering 87% of the total hospital beds under its jurisdiction. According to the Department of Health (DoH) 750 medical incinerators have been installed in hospitals under the jurisdiction of the Ministry of Public Health (MoPH) all over the country.

About 30 % of the hospitals under MoPH have on-site incinerators, 50 % disposes through private companies, and the rest 20 % manages by local authorities as shown in Figure on the left.

Waste Disposal by Incineration in MoPH Hospitals



Basic treatment of the wastes is done prior to transporting them to municipalities and Local Sanitation Administrations for those regional healthcare institutions that do not have waste disposal systems of their own.

INSTITUTIONAL ANALYSIS

Institutions governing infectious waste management in Thailand adopt both compulsory and voluntary approach.

Compulsory approach is administered by the MoPH, Public Health Committee and the Local authorities. Hospitals under the MoPH are to conduct their activities based on the ministry's policy, which mentions that healthcare facilities are to manage healthcare waste properly at source and are to comply with all regulations.

Private healthcare facilities need to comply with the Healthcare Facility Act 1998, through a permit system in which solid waste management is one of the criteria set for license. The Department of Medical Service under MoPH and the Healthcare Facility Committee takes care of the permit system.

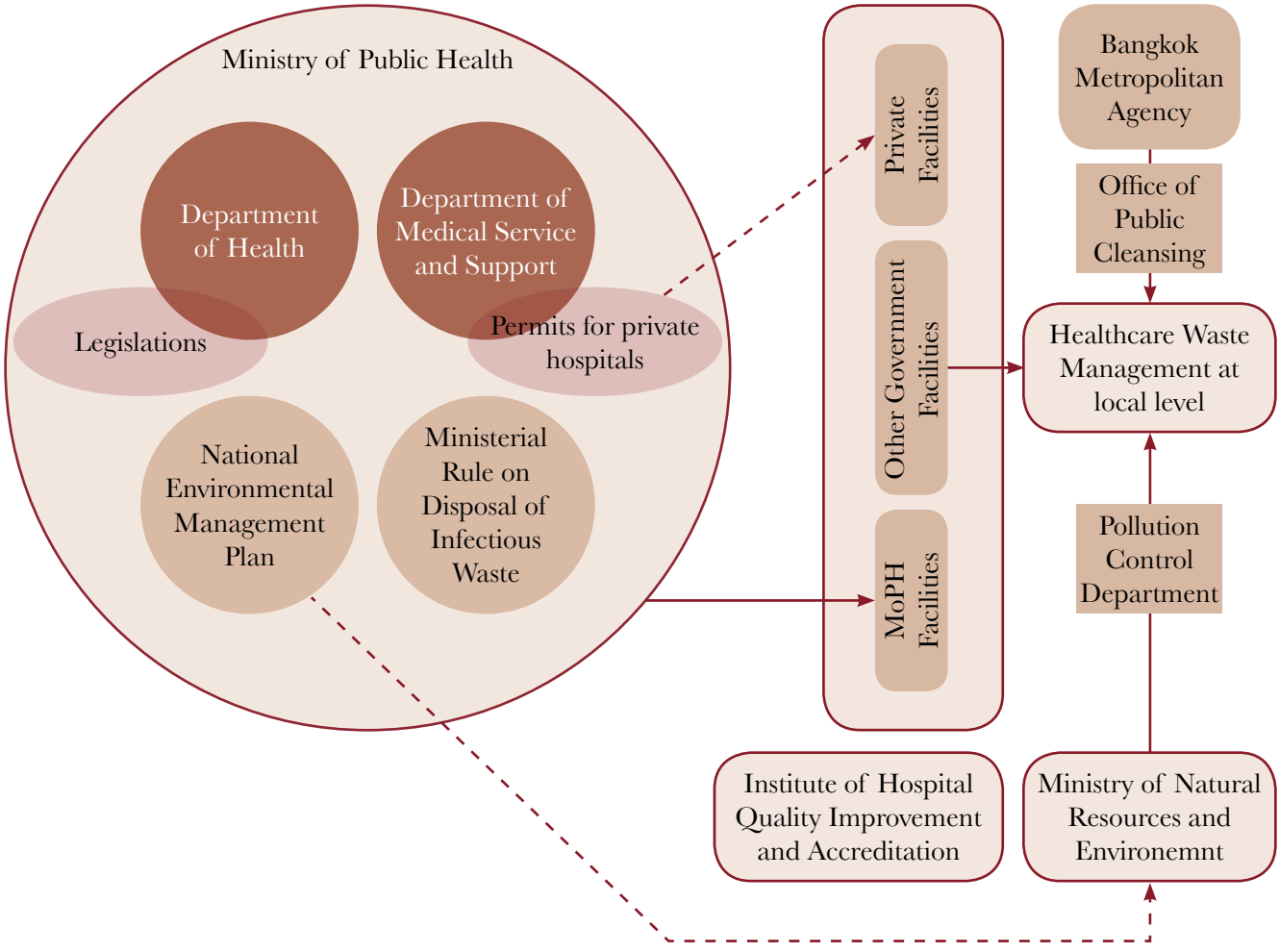
In the voluntary approach, each healthcare facility is to manage their waste based on the criteria set by specific systems, such as hospital accreditation system. The Institute of Hospital Quality Improvement and Accreditation, sets up criteria for evaluation and assesses hospital accreditation. One of the criteria set for evaluation is that the management of healthcare waste shall comply with all regulations. To encourage voluntary approach, the MoPH encourages hospitals to apply for accreditation.

At the national level, MoPH is primarily responsible for healthcare waste. It develops the Public Health Ministerial Policy on Infectious Waste Management. The DoH under the MoPH is responsible for legislations like Public Health Act, Ministerial Rule on Infectious Waste Management. The Ministry of Natural Resources and the Environment (MoNRE) and MoH develop the National Environmental Management Plan (NEMAP). The Department of Public Hygiene, of MoPH oversees the disposal of hospital wastes from hospitals under the Ministry's jurisdiction and develops / procures required facilities.

Technical matters on hospital waste management are dealt by the Pollution Control Department (PCD), DoH and the BMA. Every institution carries out its own functions independently. The Pollution Control Department oversees the performance of all related waste management facilities. The BMA has considerable autonomy and is empowered to manage all kinds of waste through the Division of Public Cleansing Services (DPCS).

The Local Government Agency (LGA) controls the collection, transfer and disposal of waste. It is their obligation to provide storage places for the transfer of waste and set appropriate disposal methods. They provide adequate personnel for the management of waste from collection to disposal. The institutional setup governing healthcare waste in Thailand is presented in Figure below.

Institutional Setup Governing Healthcare Waste Management



POLICIES AND LEGISLATION

The principal legislation governing infectious waste management in Thailand is the Public Health Act 1992 and the Healthcare Facility Act 1998.
The Public Health Act 1992 and the Amendment 2007 specifies that the collection, transportation and disposal of solid waste are the responsibility of the local authority. The local authority may conduct these duties by themselves or delegate these duties to any other person or make agreement with other local authorities/organization for central treatment operation.

The Ministerial Rule on Disposal of Infectious Waste, 2002, pursuant to the Public Health Act, specifies that healthcare facilities include all kinds of hospitals (for both human and animals), clinics, and laboratories. Every healthcare facility is to be responsible for the collection and storage of infectious waste within their facility in compliance with the Ministerial Rule. These include procedures for waste handling, designation of the personnel responsible for waste management, provision of equipment and other facilities in collection, transportation and disposal. The treated infectious waste is to be tested before disposal, to ensure complete destruction of germs. The Ministerial Rule specifies criteria for testing by using Bacillus stearothermophillus or Bacillus subtilis.

According to the Ministerial rule, healthcare facilities are to designate personnel for the collection, transportation and disposal of infectious waste. These persons are to be trained in handling infectious waste at different stages of collection, transportation, storage and disposal. Hospitals with their own treatment/disposal facility are to inform the local authority and are to operate their own treatment facility. Private companies that conduct business on hospital infectious waste management are to apply for a license from the local authority.

The Healthcare Facilities Act 1998 specifies that to operate healthcare facilities, the owner is to apply for license before operation. Healthcare Facilities Committee is to assess the facility based on criteria set by the Committee, among which solid waste management system is one.

Policies regarding infectious waste management are formulated according to the Enhancement and Conservation of National Environmental Quality Act 1992. It specifies that the Ministry of Natural Resources and the Environment and the National Environmental Committee is responsible to propose the National Environmental Quality Management Plan to the Cabinet for approval. It includes solid waste management as one part of the Plan. The Plan encourages construction or utilization of central treatment plants. The Plan has been drafted and is to be proposed to the Cabinet soon. In addition, the Ministry of Public Health has formulated policy to impose infectious waste management on all types of healthcare facilities under the Ministry, that all healthcare facilities should manage infectious waste within their facilities in compliance with the Public Health Act.

The compulsory approach discussed under Section 3.11.3, is governed by the Public Health Act 1992 and the Amendment 2007 as well as the Ministerial Rule for Infectious Waste Management 2002.

Capital
Hanoi

Area
329,560 km²

Population
86.1 million

Population growth rate
0.99%

GDP - per capita (PPP)
$2,900

GDP - real growth rate
6.3%

(Source: CIA World Fact Book, 2008)

Vietnam is the easternmost country on the Indochina Peninsula in Southeast Asia. It is bordered by China to the north, Laos to the northwest, Cambodia to the southwest, and the South China Sea to the east. The country is administratively divided into 59 provinces and 5 municipalities.

HEALTHCARE FACILITIES

In 2004 there were 13,149 healthcare facilities, of which the Ministry of Health (MoH) administrated 30 facilities, comprising 26 hospitals, one regional polyclinic, one convalescence and rehabilitation hospital, and two other facilities. The Provincial Department of Health (PDoH) managed 12,259 facilities including 800 hospitals, 857 regional polyclinics, 34 convalescence and rehabilitation hospitals, 10516 ward healthcare stations and 52 other facilities. Other sectors operated 860 facilities including 30 hospitals, 23 regional polyclinics, 18 convalescence and rehabilitation hospitals, and 789 other facilities.

District health centers are responsible for all health programs, including hospitals of approximately 100 beds that support the community health centers and polyclinics for referral and training. Provincial health services support the district hospitals and manage all health programs including specialized hospitals, clinics, preventive care, hygiene and epidemiology, drug production, pharmacies and secondary medical school. Provincial hospitals were intended to be referral hospitals dealing solely with cases referred from district levels. Table shows a profile of healthcare facilities in Vietnam.

[12] *Healthcare Waste in Vietnam : A Status Report, submitted by Mr. Nguyen Thanh Yen, Officer, Pollution Control Division/Basel and Stockholm Conventions, Vietnam Environment Protection Agency, Hanoi, Vietnam to the Thematic Working Group on Solid and Hazardous Waste*

VIETNAM[12]

MANAGEMENT OF HEALTHCARE WASTE

Healthcare Facilities in Vietnam

Type of healthcare facilities	Number of healthcare facilities	Bed strength	Healthcare staff
MoH-administrated	30	12,680	13,229
Hospital	26		
Regional polyclinic	1		
Convalescence and rehabilitation hospital	1		
Other facility	2		
PDoH-administrated	12,259	166,257	145,342
Hospital	800		
Regional polyclinic	857		
Convalescence and rehabilitation hospital	34		
Ward healthcare station	10,516		
Other facility	52		
Other sectors	860	17,374	7,434
Hospital	30		
Regional polyclinic	23		
Convalescence and rehabilitation hospital	18		
Other facility*	789		
Total	13,149	196,311	166,005

** Details to be confirmed by country representative*

Healthcare waste in Vietnam is classified as general waste, clinic waste, radioactive waste, chemical waste, and compressed air containers. However, no reliable data is available about the share of healthcare waste that can be determined as hazardous waste. Healthcare waste investigated in several hospitals in Hanoi consists mainly of biogenetic material. Clinic waste is divided into five groups:

- Group A - infectious waste
- Group B - sharps items
- Group C - clinical waste
- Group D - pharmaceutical waste
- Group E - human and animal tissues and body parts.

Radioactive waste is any solid, liquid, gaseous or pathological waste contaminated with radioactive isotopes of any kind.Chemical waste is divided into two groups; non-hazardous and hazardous chemical wastes. General wastes are the waste generated from in-patient or out-patient activities.

Classification of Healthcare Waste

Figure (left) presents the classification of healthcare waste.

A secondary estimate indicates that about 60,000 tons per annum of healthcare waste are generated in Vietnam. The main sources of hospital waste generation are from medical examination and treatment, domestic wastes generated by patients, their relatives and medical personnel, and common activities in hospitals such as kitchen wastes and garden wastes etc.Table below presents some of the results obtained during a survey for the National Master Plan on Healthcare Solid Waste Management in 2002. The Table presents the average generation of healthcare solid waste in the various categories of hospitals.

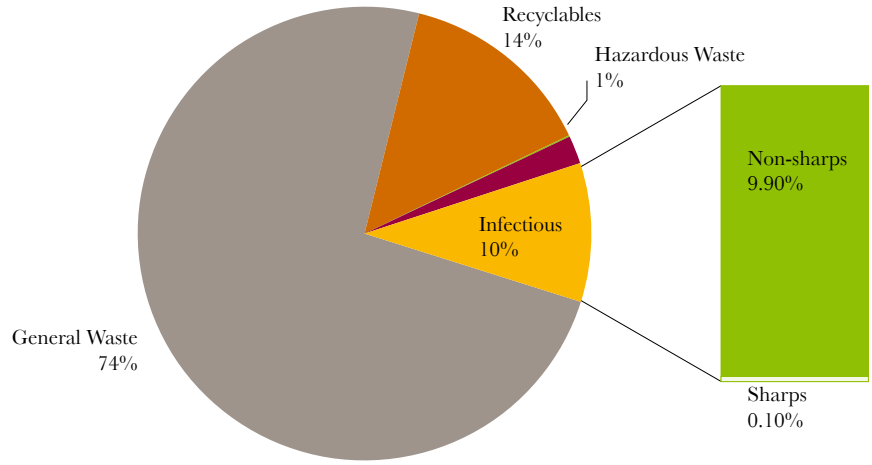
The daily generation of hazardous waste from hospitals is estimated at about 50 – 75 tons comprising about 22% of healthcare waste. The average bulk density of the healthcare waste is 150 kg/m^3 with water content of almost 40% and calorific value of 2150 kcal/kg. The healthcare waste composition from different regions in Vietnam as in 1988 is shown in Figure (top right).

Healthcare Waste Generation

Type of hospital	Average number of bed	Rate of general waste (kg/bed/day)	Hazardous healthcare waste (kg/day)	Rate of hazardous healthcare solid waste (kg/bed/day)
Central General Hospital	600	0.85-1	175	0.3
Provincial General Hospital	325	0.7-1	85	0.25
Provincial Specialty Hospital	125	0.8-0.95	25	0.15-0.25
District Hospital	75	0.6-0.85	15	0.15
Branch Hospital	65	0.6-0.85	5	0.15
Policlinic	5	0.7-0.9	<0.5	<0.1

Source: Report of the Ministry of Health, 2002 and Chi, 2002

Composition of Healthcare Waste



Color coded bins for healthcare waste collection and storage

Collection, Storage and Transportation

Laborers are responsible for daily collection of hazardous healthcare waste and domestic wastes at source and transporting them to gathering point. Medical staff members segregate the waste, bandages, and swabs in one plastic bin in the main medical examination room. Clinical wastes are put in special yellow plastic bags marked with biohazard symbol. Green bags are used for general wastes and cytotoxic drugs. Chemical and radioactive wastes are stored in special black plastic bags with labels indicating the source. Yellow boxes containing initially treated sharps and wastes are put into tight yellow plastic bags. Hospital solid wastes are classified into two categories: healthcare waste and domestic wastes. The color coded bins for healthcare waste collection are presented in Figure (middle left). Table (left) shows the type of waste and the corresponding color coded storage materials.

Color Code for Healthcare Waste Storage

Type of waste	Storage	Color code	Visual mark
Clinic waste	Plastic bags	Yellow	Symbol of biological hazard
Radioactive waste	Special plastic bags	Black	Labels of generation sources
Chemical waste	Special plastic bags	Black	Labels of generation sources
General waste	Plastic bags	Green	
Compressed air containers	Waste tank, container, plastic bags		

Source: Final report on "Building up the Plan for Healthcare Waste Management and Treatment", Ministry of Health, Project Management Board

Storage place for healthcare waste (Source: Nguyen Trong Khoa, 2005)

For domestic wastes, hospitals usually sign contract with the service companies in charge of collection in the locality, for example The Urban Environmental Companies (URENCO) serves in Hanoi and Ho Chi Minh City. Domestic waste collected by the servicing company is then transported to the municipal solid waste landfill.

Wastes generated from healthcare facilities are transported to the general waste storage of the facility at least once a day or when it is necessary. Some healthcare establishments have separate storage area for waste with access for waste-collection vehicles. Above right Figure shows the storage area for healthcare waste.

Solid waste from hospitals are collected and transported under specific contracts. Healthcare wastes are stored in specific bins containing biohazard symbol and transported to landfill sites or incinerators by specific vans. Figure below shows transportation of healthcare waste.

Transportation of healthcare waste (Source: Nguyen Trong Khoa, 2005)

Treatment and Disposal

The most common methods for treating and disposing of infectious wastes are incineration and land disposal either within the hospital premises or at disposal sites. Hospitals with incinerators carry out incineration within their facility. Hospitals without incinerators either bury the waste within the hospital premises or sterilize the waste and incinerate or bury them at the municipal graveyard. There are very few hospitals with incinerators, and the existing ones are old and manually operated.
In Ho Chi Minh City, individual hospitals manage their wastes through a contract with the Ministry of Construction for collection and combustion in existing incinerators. The incineration facility is operated by Ho Chi Minh City Environmental Company (CITENCO) and is located in a crematorium. CITENCO collected about 3500 kg of clinical waste from healthcare facilities in and around Ho Chi Minh City. There are totally 61 healthcare waste incinerators, of which 47 were imported, 14 are locally made, operating with 20-25% of their capacity. According to Ministry of Health regulations on healthcare waste, incinerators should be of two-chamber operating at a minimum secondary chamber temperature of at least 1050° C. The Table (right) shows the category of waste and the corresponding method of treatment and disposal.

Investments on waste management in Vietnam have increased rapidly from nearly USD 11.5 million (VND 195 billion) in 1998 to nearly USD 65.3 million (VND 1100 billion) in 2003, with about 12 % for medical waste.

Healthcare Waste and Methods of Treatment and Disposal

Type of waste	Method of treatment	Method of disposal	Remarks
Clinic waste			
Group A Infectious waste		Burying in ground Incineration Open burning	Within hospital premises or at disposal facility
Group B Sharp items	Disinfection of sharps by sterilized solution	Burying in ground Incineration	Segregation of pointed/sharp items PE bottle or puncture-proof boxes or containers
Group C Clinical waste	Pre-treatment by using disinfection chemicals, hypochlorite, liquid chlorine, chloramines	Burying in ground Open burning	Within hospital premises or at disposal facility
Group D Pharmaceutical waste		Incineration Open burning	
Group E Human and animal tissues and body parts		Burying in ground Incineration Open burning	Within hospital premises or at disposal facility
Chemical waste	Treatment in town or region	Return to the supplier Professional waste collection	Safe storage
Compressed air container	Treatment in town or region	Return to the supplier Professional waste collection	Safe storage
Radioactive waste			Missing technical and safety control
General waste		Dumping site	Contract with town's environmental company for collection

Figure below shows incineration of healthcare waste.

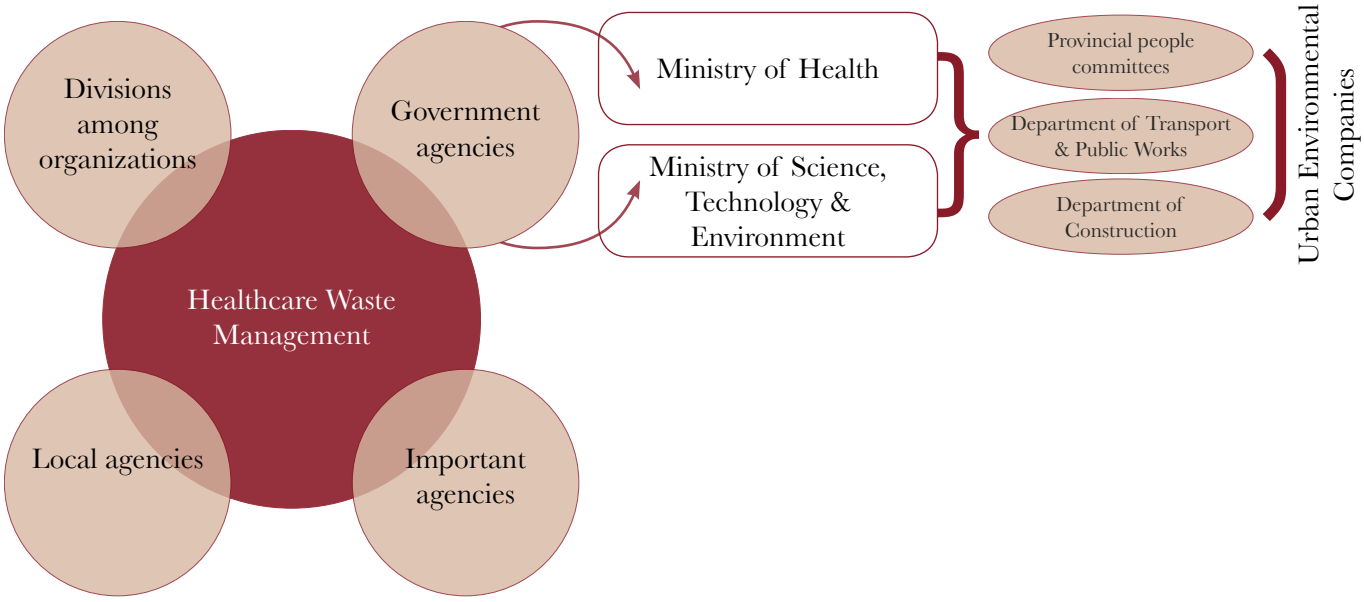
Incinerators for Healthcare Waste

INSTITUTIONAL ANALYSIS

At the national level, healthcare waste management is under the scope of Ministry of Health (MoH) and Ministry of Science, Technology and Environment (MoSTE). Other local agencies and organizations for healthcare waste management also share responsibilities of management, collection at source, storage in healthcare facility and transport. In addition, Department of Plan and Finance, Department of Legislation, Department of Therapy, Department of Science and Education also hold responsibility for hospital and healthcare institutionalization, infection management, epidemic hygiene, occupational health and environment. Figure below presents the institutional setup governing healthcare waste in Vietnam.

The Ministry of Health is responsible for supervising, checking and enforcing the hospitals, healthcare stations and healthcare service facilities to comply with the regulations. It also takes lead and cooperates with the Ministry of Construction in the planning and selection of technologies, equipments, construction and operation of healthcare waste incinerators and systems that meet the Vietnam environmental standards. In addition, the Ministry issues healthcare waste management regulations.

Institutional Setup Governing Healthcare Waste Management



Ministry of Science, Technology and Environment is responsible for:

- Undertaking the unified governmental management of hazardous waste in Vietnam; organizing and directing hazardous waste management
- Developing legislative documents on hazardous waste management
- Issuing the register for hazardous waste management or environmental permit for the release source, collection, transport, storage, treatment and disposal of hazardous waste
- Publishing environmental standards on the selection of landfill for hazardous waste, technical standards on the engineering, construction and operation of storages and landfills for hazardous waste, assuring the environmental hygiene; selecting and consulting technology for hazardous waste treatment; cooperating with Ministry of Finance in setting the fee for hazardous waste management
- Guiding and approving the Environmental Impact Assessment of the collection, transport, storage, treatment and disposal facilities and landfills for hazardous waste
- Studying and applying scientific and technological achievement in hazardous waste management
- Organizing the survey and assessment on environmental pollution in storages, treatment and disposal facilities and landfills for hazardous waste; inspecting and checking hazardous waste management activities pursuant to applicable legislations
- Disseminating, training and raising the awareness of hazardous waste management
- Taking lead and cooperating with relevant ministries, sectors and localities in the dissemination of Hazardous Waste Management Regulations in Vietnam.
- Cooperating with relevant ministries and sectors in training expert and profession for hazardous waste management staffs.
- Cooperating with relevant ministries and sectors in raising the awareness of hazardous waste management of authorities and public through communication media.
- Annually cooperating with relevant ministries, sectors and localities in inventory on hazardous waste, assessing the status of hazardous waste management in Vietnam and reporting to the Government.

Hazardous healthcare waste management is mainly undertaken by MoH and MoNRE. At the local level, it is undertaken by Provincial People's Committees and Urban Environmental Companies directly under the Provincial People's Committees or Departments of Transport and Public Works and Departments of Construction.

POLICIES AND LEGISLATIONS

In Vietnam, there are laws, regulations and/or guidelines relating to the management of hazardous wastes, including healthcare wastes. The MoH has issued guidelines for managing healthcare wastes. Some circulars have drawn attention to the poor practice in storing, transporting and disposing of healthcare wastes and made recommendations for improvement. The management of healthcare waste in Vietnam at the moment is based on Decision 2557/BYT-QD dated 26 December 1996 and the Regulation on healthcare waste management issued by the MoH on 29 August 1999. There are several new regulations and national standards on the technical requirement for healthcare waste incinerators, air emission standards and discharge effluent standards from healthcare wastewater treatment plants. The existing regulations relating to healthcare waste management and healthcare waste treatment facilities are summarized in Table.

Summary of Regulations on Healthcare Waste Management

Policy/Regulation
Official letter No 4527-BYT Ministry of Health
Official letter No 87/TTr Ministry of Health
Decision No 1895/1997/BYT-QD Ministry of Health
Official letter No 1153/VPCP-KGGovernment office No 1069 CP/QHQT Government office
Decision No 152/QD-TTg Prime Minister
Decision No 155/1999/QD-TTg Prime Minister issued on the Regulation on hazardous waste management
Decision No2575/1999/QD-BYT Ministry of Health
TCVN6560:1999 Air quality – emission standard for medical solid waste incinerator
Decision No 62 /2001/QD-Mnister of Science, Technology and Environment
Decision No 60/2002/QD-BKHCNMT The Minister of Science, Technology and Environment
TCVN7382:2004 Water quality- Hospital waste water – discharged standards
TCVN7381:2004 Healthcare solid waste incinerator – Method of specification appraisement
TCVN7380:2004 Healthcare solid waste incinerator- Technical requirement
Environmental Law (revised one)

	Description
	Guidelines on healthcare waste treatment in hospital
	Guidelines for inspectors in cities/provinces health services on healthcare waste management in hospitals.
	Regulation on hospitals
	Assign the Ministry of Health in actively coordinate with concerning sectors/ministers to develop the master plan of healthcare solid waste management in the whole country.
	Strategy for solid waste management in urban and industrial zones in 2020. Target 2005 -2020: Collection and treatment of solid healthcare waste by burning method in big cities.
	Hazardous waste classification. Identify the responsibilities and functions of workers who collect and transport and disposal wastes. Identify MoH's responsibility on 1) Monitoring, developing effective obligations for hospitals¸ coordinating with the MONDRE, Ministry of Construction in making master plan, choosing technology/equipment/construction investment and operating system of medical waste incinerators compliant to Vietnamese environment standards. 2) Issue the regulations of HCWM
	Regulation on healthcare waste management
	Emission standard for medical solid waste incinerator
	Regulation on technical requirements of incinerators for healthcare wastes. Minimum requirement for the second chamber of the incinerator do not less than 1050^{0}C with retention time >1s. Capacity <400kg/day should have wet spray cleaner, capacity >400kg/day should have dry cleaner
	Issue on Technical guidelines on hazardous waste burying.
	National discharged standard for hospital wastewater
	Method for evaluating medical solid waste incinerator
	National technical requirement for medical solid waste incinerator
	Ministry of Health in charge of environmental protection in healthcare sector

INTERNATIONAL AND NATIONAL INITIATIVES

Several international and regional organizations have initiated projects to improve healthcare waste management in Vietnam. The Table presents a list of relevant projects and implementation organizations.

International and National Initiatives for Healthcare Waste Management

Implementing Organization
Center for Environmental Technology Transmission, Training and Consultancy
Center for Environmental Technology Transmission, Training and Consultancy
Japan International Cooperation Agency – Vietnam Environmental Protection Agency, 2005
Center for Environmental Engineering in Towns and Industrial Areas – Hanoi University of Civil Engineering, 2003
Department of Health – Hai Duong People's Committee, 2004
Ministry of Health, 2000-2003 (USD 5 million loan from Austrian Government)
Ministry of Natural Resources and Environment, 2004-2009 (USD 24 million ODA from Swedish International Development Cooperation Agency)
PATH USA (ongoing)
MoH-BURGEAP France
European Union
WHO, 1995-1999 (489.000 USD)
URENCO (2006-2008)
GEF-UNDP-MONRE (2008-2011)

	Description/Project Information
	Developing the model for healthcare waste safe management and reducing environmental pollution: Component: "Healthcare solid waste management and model development"
	Developing possible pollution treatment for public areas. Component: "Hospital hygiene status assessment, hospital solid waste management and model development"
	Enhance medical waste management and control capacity of hospitals in the list of polluting hotspots
	Development of technology for incinerator and waste gas treatment in industrial hazardous waste incinerator, appropriate with the condition of Vietnam
	Healthcare waste treatment project in Hai Duong, 2005 – 2010
	Installation of 25 medical waste incinerators for hospitals
	The Vietnam - Sweden Cooperation Programme on Strengthening Environmental Management and Land Administration
	Sharps Shredder Project in Ha Tinh province
	Developing Master Plan on Healthcare Waste Management
	Healthcare System Development in Binh Thuan and Thai Binh provinces
	Management of healthcare waste and associated risks
	Hanoi healthcare waste treatment project
	Demonstrating and Promoting Best Techniques and Practices for Reducing Healthcare Waste to Avoid Environmental Releases of Dioxins and Mercury

4

GLOBAL EXPERIENCES AND LESSONS TO LEARN


TIENAM
500
MSD
Rocephin

INTRODUCTION

Procedures and systems to be adopted for better healthcare waste management are available in ample from various sources and it is not impossible to find such materials in the present information world. With the advent of modern technologies, healthcare waste is rather looked upon as a technical and engineering issue than a management problem.

Be it the story of Naples, Italy where a landfill was recently closed and thousands of tons of uncollected trash lined the roads or the massive slide of the Payatas Dumpsite in the Philippines costing hundreds of lives. Regardless of the economic status of these countries, it is the waste that was sent to the disposal site that caused the crisis. Had the waste been avoided from reaching the disposal facility by diverting it to a recycling facility instead, the issue could have been circumvented. Diverting waste to proper recycling is a simple management practice that could have saved significant financial and human losses in both cases. Often good management practices can provide simple solutions to complex problems.

As the great scientist Benjamin Franklin quotes "Experience is the best teacher" and it is far better to learn from other's experience, be it good or bad. This Chapter presents both good and bad experiences gained from initiatives in various countries. An attempt has been made to present some good examples of management practices that could produce factual results.

Healthcare Waste Management involves various stages, beginning at the point of generation to final disposal. Small differences in the operation at any given stage could produce bigger and better results in the succeeding stages and hence, though healthcare waste management is a system, a fragmented approach is required to unleash the synergy. The following sections of the report demonstrate some of the good and bad practices at the various facets of healthcare waste management. Besides, where relevant, the hazards of improper management of the waste have been explained.

SEGREGATION AND COLLECTION

The first obstacle to be triumph over for better healthcare waste management is the tendency of failing to see different waste categories as different they are. Segregation of different waste categories is critically important to enable proper disposal. Approximately 80% of all healthcare waste can be disposed through regular municipal waste methods or sent for recycling as in the case of other domestic waste. It is the other 20% that are potentially infectious and supposed to create serious health threats to healthcare workers and communities if not disposed following prescribed methods.

Recycling Project at Hospital Lam Wah Ee, Penang, Malaysia

Hospital Lam Wah Ee is a charity hospital by the people and for the people to complement and supplement the health services provided by the Government of Malaysia. The hospital is located at Penang, Malaysia. Waste generated in the hospital is segregated into clinical waste, general waste and recyclable waste at the source, bagged and binned following specific guidelines outlined in the hospital's Infection Control Manual. Clinical wastes are autoclaved where applicable and sent for incineration. General wastes are collected by the local authority and disposed in the dumpsite. Recyclable wastes are sold to buyers and the proceeds are used to help hospital staff in need or used to respond to emergency situations, for example, donation for tsunami victims.

The recycling project started in 2002 with the objectives of environmental protection and generating funds for staff welfare. A Recycling Project Committee was set up in June 2002 with 19 members and every member assigned specific duties to be taken up in turns. Ideally, every member either sorts the recyclable items according to their categories one day before the sale or verifies the weight of recyclable items in turns every week.

Old newspapers, books/magazines/loose papers, cardboards, clear plastic bottles, coloured plastic bottles, drip bottles, glass bottles, tins/cans /cooking oil bottles, aluminum cans, plastic bags, wearable old clothes and even old car batteries are collected by the recycling committee.

Between July 2002 and June 2006, in about 48 months, the hospital sold about 298,000 kg of recyclables and earned revenue of MYR 71,600 (USD 20,200). Recycling practice in the hospital is a classic example of how 3R principles can be integrated in any healthcare institution and how the segregation of infectious waste and general waste has to be done.

For more details:
Lam Wah EE Hospital, 141, Jalan Tan, Sri Teh Ewe Lim, 11600, Penang, Malaysia
www.hlwe.com.my

All waste generated in a healthcare facility is infectious is a myth that has to be cracked to put into action a healthcare waste management system. Recycling activities in Lam Wah Ee Hospital at Penang, Malaysia is a good example of how a hospital can reduce the amount of waste it has to dispose and in parallel generate revenue.

Without the source segregation and recycling activities in place, the hospital would have had to dispose the general waste along with the infectious waste thereby resulting in unwanted disposal costs. By having a clear plan, the hospital has been able to reduce the amount of waste that it had to manage as infectious, yet making additional revenues for its staff welfare.

HANDLING AND TRANSPORTATION

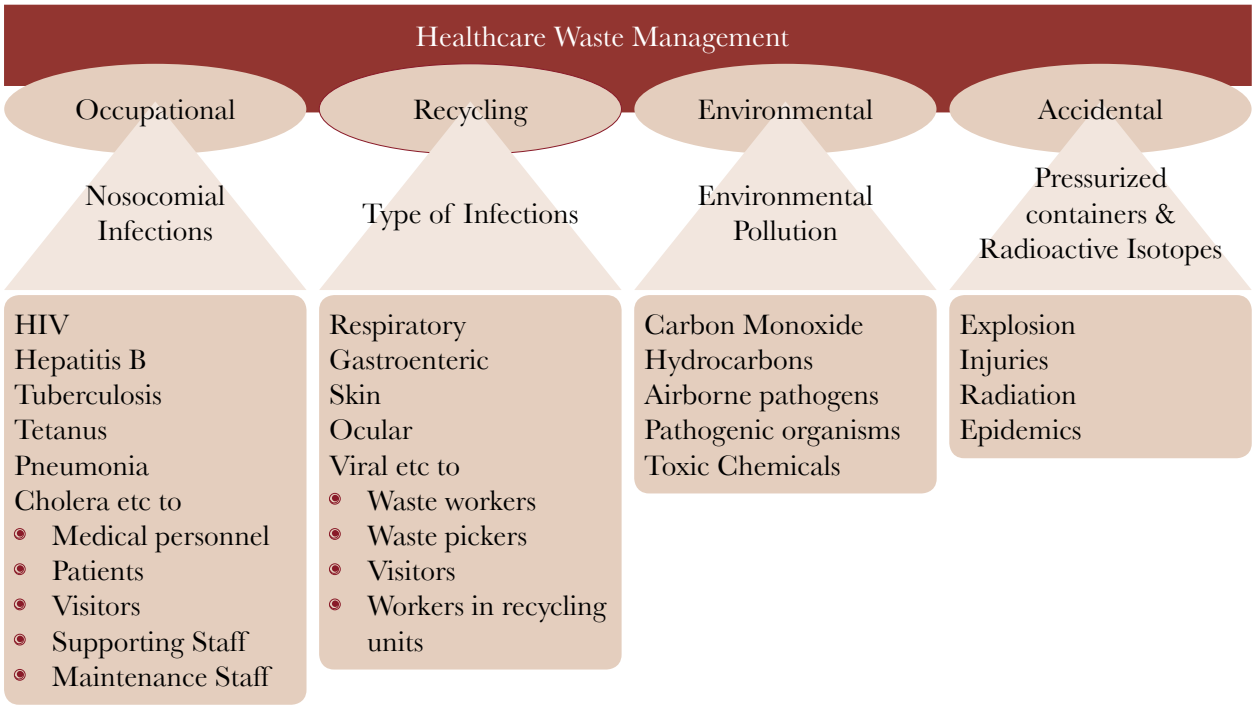
In many developing countries, healthcare waste seldom receives due attention and often handled as part of the municipal waste stream. Physicians, healthcare staff and workers often do not realize the flipside of their negligence and the disorder it causes later. Nevertheless, awareness of the perceived and real problems of handling and disposal of healthcare waste is now increasing. While procedures for proper healthcare waste management are lavishly discussed, not much thought has gone into disseminating the health risk arising from poor management of healthcare waste. A rapid survey of literature on healthcare waste can prove this beyond argument.

Mishandling of healthcare waste can turn into a threat to public and the environment at large if the most common pathways of infection such as direct contact, contact through vectors, airborne transmission and water sources are not obstructed. The Table lists the widespread risks, pathways, hazards and possible victims of improper healthcare waste management. Nonetheless, the risks due to improper healthcare waste management differ between population groups. Specific groups coming into direct contact with healthcare waste include waste pickers, waste recyclers, drug addicts (who scavenge for used needles and disposed medicines); hospital sweepers and other low-grade hospital staff. They can be affected either through direct contact with waste at work everyday or through dependency on existing healthcare waste for scavenging it to generate income for livelihoods. Healthcare workers, healthcare waste workers and municipal waste workers are usually underprivileged and have little education thus turning to waste picking as an additional revenue generating option. This group of people should be provided with protective equipment and receive basic training. On the other hand, very low-income families, such as those who depend on waste picking, living in squatter settlements or even within a waste dump are prone to high risk.

Consequences of Improper Healthcare Waste Management

Risk	Pathway	Hazard	Possible Victims
Contraction of disease/infection	Direct or indirect contact through a carrier	Pathological wastes and infectious wastes may transmit disease and infection through direct contact or via vectors	Hospital Staff, laborers, waste pickers, waste management facility staff
Cuts	Direct contact	Sharp waste including syringes, glass and scalpels may cause cuts which provide an entry into the body for infection: for example, used syringes may be recycled by unscrupulous medical practitioners, or played with by children and are potential transmission routes for HIV and Hepatitis B	Hospital Staff, laborers, waste pickers, waste management facility staff, unaware patients and any other coming into contact
Ineffective medical care	Direct	Consumption of expired pharmaceuticals possibly through inappropriate prescription by unscrupulous medical practitioners	Patients
Cancer	Direct or indirect contact, or proximity to waste	Radioactive waste	All those exposed to the radiation zone
		Toxic chemicals	Laborers, waste pickers, waste management facility staff
Burns and skin irritation	Direct or indirect contact, proximity to waste	Radioactive waste	Hospital staff, laborers, waste pickers, waste management facility staff
Injury from explosion	Being within the vicinity when explosion occurs	Pressurised containers	Laborers, waste pickers, waste management facility staff
Pollution of groundwater, surface water and the air	Direct or indirect contact with polluted water or release to the atmosphere	Toxic chemical wastes	General public
		Pharmaceuticals	General public
		Waste with high heavy metal content	General public

Source: Modified from Appleton and Ali, 2000



The Table highlights the degree of risk level for different group of population prone to be affected by the improper healthcare waste management. Above Figure presents the health risks at various stages of contact with healthcare waste.

Potential Risk Levels from Healthcare Waste

Stakeholder	Stakeholder Sector	Risk Level
Waste Pickers	Informal Sector	Very High
Drug addicts	Community	Very High
Recycling industry: - Itinerant waste buyers - Middle dealers - Main dealers	Informal Sector	High
Children from low income families	Community	High
Healthcare waste workers Sweepers in hospitals Other low grade hospital staff	Formal	High
Municipal waste workers	Formal	High
Low income families	Community	Medium to High
Healthcare workers	Formal	Medium
Healthcare facility visitors and care takers of patients	Community	Medium
Middle income families	Community	Low

Source: Modified from Appleton and Ali, 2000

TREATMENT AND DISPOSAL

Given the inherent risks of handling healthcare waste and the need to have a formal segregated collection system, the next key step is the treatment of the waste. Various technologies are available for the treatment of healthcare waste. An understanding of the waste category and the volume is vital before one decides the technology to be adopted. As being continuously reiterated throughout this report, it is not the entire waste stream from a healthcare facility that is infectious and requires special treatment. Different waste categories have to be handled differently. Healthcare waste treatment technologies, especially for the infectious waste have been broadly classified into burn and non-burn technologies, and have their inherent merits, demerits and application criteria. A detailed listing of various non-burn technologies is presented in Technology Fact Sheets section of this report.

The most commonly proclaimed treatment technology for healthcare waste is incineration, where the waste undergoes combustion under controlled conditions. However, in the recent years the shortcomings of incineration have been largely realized and are no more agreed as environment friendly. In fact, environmentalist argues incinerators to only change the form of the waste, still retaining the hazards. Essentially, an incinerator burns the waste and leaves behind toxic ash and noxious gases with harmful air pollutants.

A healthcare waste incinerator releases a wide variety of pollutants including the most known dioxins and furans, metals (such as lead, mercury, and cadmium), particulate matter, acid gases (hydrogen chloride and sulfur dioxide), carbon monoxide, and nitrogen oxides. These emissions are claimed to have serious adverse consequences on worker safety, public health and the environment. Dioxins, for example, have been linked to cancer, immune system disorders, diabetes, birth defects, and other health effects. Healthcare waste incinerators are a leading source of dioxins and mercury in the environment.

Ash remaining at the bottom of an incinerator often contains heavy metals. Dioxins and furans may also be found in the bottom ash. Where low-level radioactive waste is incinerated, the ash residue may also contain traces of radioactive isotopes. In the event of presence of toxic metals in the ash then the ash itself becomes hazardous waste and needs to be suitably disposed following prevailing regulations.

Fly ash (ash that is carried by the air and exhaust gases up the incinerator stack) contains heavy metals, dioxins, furans, and other toxic chemicals that condense on the surface of the ash. Even when the fly ash is removed from the exhaust stream by pollution control devices such as baghouse filters, the toxic materials remain concentrated on the filter cake and should be treated as hazardous waste.

No single technology offers a panacea to the problem of healthcare waste disposal. In general, however, non-burn technologies appear to emit fewer pollutants, cost-effective, compact, reliable and generating secondary pollution. Most non-burn technologies generate solid residues that are not hazardous. Looking at the downside of finding suitable technologies, it is always better to take a preventive approach and engage in waste minimization and segregation.

Box below presents information on healthcare waste treatment, including the cost of treatment in the Delhi, the capital of India.

Scenario of Biomedical Waste in Delhi, India

Healthcare waste generation in Delhi, the capital of India, is approximately 22.5 tons/day. Government hospitals and major private hospitals have their own arrangement for treatment of healthcare waste, often referred as biomedical waste in India.

Biomedical waste generated in 30 Delhi government hospitals vary from, for example, 0.78 kg/bed/day at Shushruta Trauma Centre to 0.30 kg/bed/day at Guru Nanak Eye Centre and some other hospitals even much lesser indicating an overall average of 0.26 kg/bed/day. Similarly, biomedical waste generated in 31 hospitals other than Delhi government vary from, for instance, 0.58 kg/bed/day at the Infectious Disease Hospital to 0.30kg/bed/day at Venu Eye Institute and Research Centre and much lesser in other hospitals indicating an overall average of 0.20 kg/bed/day.

In Delhi, biomedical waste management services are offered by Biocare Technological Services and Synergy Waste Management Company in addition to onsite treatment facilities owned by the hospitals. Some smaller clinics/laboratories do not utilize the services of the operators and do not posses proper for authorization. At present in Delhi 18 incinerators, 18 autoclaves and 3 microwaves are in operation. Besides this, Synergy Waste Management Private Limited established a treatment facility at Okhla in November 2006.

Under the 10th Five Year Plan, the Delhi Government has established a Biomedical Waste Management Cell to monitor biomedical waste management in Delhi. All hospitals under the Delhi National Capital Territory Government are to have separate budget for Biomedical Waste Management.

The cost of biomedical waste treatment varies from Rs. 770/bed/year (USD 17) in Attar Sain Jain hospital to Rs. 14,000/bed/year (USD 310) in RB Seth Jessa Ram Hospital. The average cost works to about Rs.5,300/bed/year (USD 117). The average expenditure for institutions having onsite treatment facility works to about Rs. 7230/bed/year (USD 160) whereas the institutions using centralized facility are spending only Rs. 2100/bed/year (USD 46), less than 30% of the cost of onsite treatment. However, the level of treatment and the technology utilized make a difference still implying centralized treatment could be cheaper.

In view of the difficulties faced by private hospitals, nursing homes and clinics, that cannot make their own arrangements due to high cost involved in treatment facilities, there is a need for centralized system for treatment. In order to facilitate the proper treatment of the biomedical waste generated from smaller nursing homes, clinics, blood banks and diagnostic laboratories the government is taking initiatives to establish centralized waste treatment facilities.

(Source: BWMC, 2006)

INTERNATIONAL EXPERIENCES

Ireland

The Government of Ireland has decided to treat medical waste by a non-incineration technology. Until recently, approximately 50% of healthcare waste was incinerated on-site and 50% landfilled. In a recent development, a joint Irish North/South Body, Joint Waste Management Board contracted Sterile Technologies Ireland (STI), a private waste management company, for dealing with medical waste in Ireland.

Sterile Technologies Ireland use a process of shredding waste prior to treatment followed by the injection of steam, for a complete elimination of pathogenic micro-organisms. Key parameters are continuously monitored and recorded providing for a safe, clean and accountable process of healthcare waste. The unrecognizable waste is held pending until it is verified and scientifically defined as sterile, before sending for disposal.

The current position in Ireland is that 95% of all medical waste treated on the island receives segregation at source into specific disposal streams of domestic and medical waste. Medical waste is stored in wheeled bins at each hospital facility and transported with electronic tracking from its point of production to its final disposal. This way of dealing with medical waste changed the perception that incineration was the only safe method for healthcare waste disposal.

Generally, two types of waste cannot be shredded. First type is packaging waste that is not sealed properly, or is damaged, punctured or leaking and those packed without an identifiable name tag or not labeled to denote source and contents. This category if managed can change and be processed. The second category is waste that cannot be processed using the STI shredding system. Cytotoxic, sharp and non-sharp waste, recognizable anatomical waste i.e. limbs, organs, waste containing pathogens, making approximately 3% of the overall medical waste in Ireland is exported to an incinerator in Belgium.

Portugal

Until 1995, environmentally sound medical waste management in Portugal was virtually non-existent. Legislation divided medical waste only in two categories: Non-hazardous waste and hazardous waste. There was a very weak source separation system and as a result 50% of the waste (25,000 tons/y) was considered hazardous. The final destinations of the hazardous waste were 40 on-site medical waste incinerators. Due to public pressure, in 1996 the Government approved a new legislation that encouraged the autoclaving of infectious waste. In 1998 the Government approved the National Plan for medical waste with the target of phasing out 30 existing incinerators, keeping only one or two incinerators for the whole country in 2000.

The amount of hazardous medical waste has been steadily decreasing since 1995 (25,000 tons in 1995, 16,469 tons in 2001, and 15,336 tons in 2002) due to a better segregation of waste. From 1996 to 1998, two big autoclaves were built, which nowadays treat more than 80% of the total hospital hazardous waste produced in Portugal.

Italy

An Italian Hospital located in Rome has been chosen as an example of well-integrated waste management and disposal of medical wastes. The hospital is specialized in the neuro-motor rehabilitation of patients suffering from different diseases (strokes, amputations, paraplegia, etc.). The hospital produces roughly 42 kg/day per 1.260 kg/month. The waste originating from the activities of the hospital can be classified as special (those from long-term stay) and hazardous (those from research laboratories) but it also includes municipal waste not coming from medical activities. More generally, waste originated from medical activities are divided into:

- Non Hazardous Medical Waste
- Non Infectious Hazardous Medical Waste
- Infectious Hazardous Medical Waste
- Medical Waste similar to Municipal Waste
- Medical Waste Requiring Special Management Systems

Recovery

The hospital produces many items that can be recycled, reused or recovered, such as:

- Glass containers for medicines, food, drinks, infusion solutions without cannulas or needles visibly not contaminated with blood, not radioactive and not coming from patients in infective isolation
- Other waste for packing in glass, paper and cardboard, plastic or metal excluding the hazardous ones (e.g. empty medicine boxes, magazines and newspapers, residues administrative activities, paper bags)

Non hazardous metal waste (All these wastes are sent to dedicated and authorized recovery plants)

- Gardening waste
- Waste originating from the preparation of meals
- Non-delivered radiological fixing liquids
- Mineral, vegetal and fat oils
- Exhausted batteries
- Toners of photocopy and fax machines, laser printers
- Mercury
- Films and photographic sheets

The Centre Hospitalier in Roubaix, France

The capacity of the Centre Hospitalier in Roubaix is 2000 beds, with the generation of 1 ton of waste (all types of waste) per bed annually. The composition of the waste in the hospital is as follows.

- Hazardous medical waste - 15% (3% of which are anatomical parts and cytostatics, the rest is infectious waste)
- Non-infectious waste - 85% comprising of special industrial waste 2%, ordinary industrial waste 3%, 80% similar to household waste of which 45% is recyclable

Before 1993, the hospital in Roubaix incinerated its waste without much segregation in an on-site incinerator. In 1993, it was decided to shut down the incinerator, and look for other disposal methods. It was decided to pre-sort waste at the source and to treat its infectious part using a non-burn method based on hot steam. In August 1993, the hospital bought a shredding, steam treatment and drying technology. According to the hospital, the system was chosen because it decontaminates infectious waste using a steam-based process at 138°C, and the internal shredder reduces the initial volume of waste by 80%. Collection and sorting waste at source was adopted to avoid professional risks for staff at the hospital and for workers that collect waste. This also reduces transport costs. The cost objectives have been met. The annual global cost of waste management at the hospital has been reduced by 30%.

As mentioned in the earlier section of this chapter, it is wiser to learn from the experiences of others, not only the good practices but also the dreadful examples. The objective of providing this bad example in the Box (right) is only with idea of bringing to limelight a possible issue that other countries might have to confront if due care is not given to the proper and safe disposal of healthcare waste.

Recycling of Syringes, Pakistan

Karachi is Pakistan's largest city, with a population of over 10 million. In June and July 2000, a study was conducted in 44 clinical laboratories with the highest workloads in Karachi. About 26 clinical laboratories were found to be dumping used syringes along with general community waste sites built by the local municipal government for the collection of general waste, not healthcare waste. A meager three laboratories used the municipal waste collection system. Four of the clinical laboratories reported selling used syringes to healthcare waste dealers. About 15 of 17 housekeeping employees at the clinical laboratories acknowledged selling used syringes to healthcare waste dealers. The reported selling price varied from PKR 3 to 10/kg (USD 0.06-0.19).

Visits to 26 dumpsites where clinical laboratories dump their waste showed that nearly 25 scavengers earn their livelihood sorting and collecting healthcare waste, including the used syringes. They reported collecting nearly 25 syringes a day and selling them for PKR 3 to 10/kg (USD 0.06-0.19) to healthcare waste dealers.

Tracing down the chain, about 10 healthcare waste dealers were contacted and almost all acknowledged trading healthcare waste and reported selling used syringes to major dealers specializing in used syringes and located in the main waste recycling business area of the city.

Further down the chain, eight major dealers of used syringes were contacted and all reported selling used syringes to the plastics industry. Most of the used syringes were crushed into small granules for the manufacture of plastic items (eg, coat hangers or buckets). Paradoxically, six dealers offered to supply used syringes to the investigators. Among them, two dealers offered to supply intact syringes after proper cleaning. One dealer offered to supply the syringes after proper cleaning and repackaging.

(Source: Mujeeb et al, 2003)

POLICY AND LEGISLATION

Excluding the developed ones, very few developing Asian countries, have integrated healthcare waste specific policies to tackle the issues. Where regulations address healthcare waste they are either a subset of other existing regulations or part of the powers vested on departments related to the issue. It is indeed good to have some level of sharing between ministries such as the health, environment, and industries to converge their focus on healthcare waste. However, a lack of a specific policy or legislation to address healthcare waste is highly undesirable and needs to be rectified immediately. For example, the Bio Medical Waste (Management & Handling) Rules, 1998, enacted by the Government of India roughly a decade back should be considered by governments that do not have healthcare waste specific regulations. The Bio Medical Waste (Management & Handling) Rules, 1998, of the Government of India comprehensively address healthcare waste management at all layers and stipulates standards for treatment options. The left Box provides an outline of the Rules for easy reference.

Bio Medical Waste (Management & Handling) Rules, 1998, of the Government of India

Realizing the hazards of improper treatment of hazardous healthcare waste, the Government of India enacted the Bio-Medical Waste (Management and Handling) Rules in 1998. The rule applies to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio medical waste in any form.

According to the Rules it is the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.

The Rule places clear guidelines on the segregation, packaging, transportation and storage of bio-medical waste in conformance to internationally accepted standards. The Rule also restricts and prevents the storage of healthcare waste not more than 48 hours.
Further the Rule emphasizes that the Government of every State and Union Territory should establish a prescribed authority for granting authorisation and implementing these rules.

Apart from providing detailed guidelines on the categories of bio-medical waste, the Rules also recommends treatment options that are to be adhered. Other key aspects covered in the Rules are:

- Colour Coding and Type of Container for Disposal of Bio-Medical Wastes
- Standards for Treatment and Disposal of Bio-medical Wastes
- Standards for Incinerators (Operation and Emission)
- Standards for Waste Autoclaving (Recording of operational parameters, Spore testing, Routine Test)
- Standards for Liquid Waste
- Standards of Microwaving
- Standards for Deep Burial

The full text of the Rules can be viewed online at http://envfor.nic.in/legis/hsm/biomed.html

Source: MOEF, 2008

TRAINING AND CAPACITY BUILDING

It is evident that healthcare waste management is a topic that requires awareness on the issues and the risk of contracting diseases when not managed properly. Health risks can be avoided only if the waste is properly segregated at the source, the infectious part of the waste contained from external access and then sent for appropriate treatment. The number of players involved in this chain of activities is so huge and with diverse educational backgrounds, from specialist

Certificate in Healthcare Waste Management: Joint Programme of IGNOU-WHO SEARO

Indira Gandhi National Open University (IGNOU) is the largest open university in the democratic world and was established by an Act of Indian Parliament in 1985. Today it serves the educational aspirations of about 1.8 million students in India and 32 countries abroad through 21 Schools of Studies and an elaborate network of 58 Regional centres, 1804 study centres, and 49 overseas centres.

The concern for biomedical waste management has been felt globally with the rise in deadly infections such as AIDS and Hepatitis B and indiscriminate disposal of healthcare waste. The United Nations, through Basel Convention has classified healthcare waste to be the second most hazardous waste, only after radioactive waste.

Realizing that the main bottleneck to sound healthcare waste management is often lack of training and appropriate skills, insufficient resource allocation and lack of adequate equipment the need to educate different healthcare professionals/workers, NGO's and other stakeholders was felt. To cater the needs of healthcare professionals, IGNOU and WHO SouthEast Asian Regional Office decided to develop and launch a certificate programme in healthcare waste management, in the SouthEast Asia Region Countries. The programme is of 6 months, through open and distance learning and was launched in July 200 and designed with the objectives of

- Sensitizing the learners about healthcare waste and its impact on health and environment.
- Acquainting the learner group to existing legislation, knowledge and practices regarding healthcare waste management practices in South East Asia Region countries.
- Imparting knowledge on the systems and technologies in healthcare waste management and their practical aspects.

The course offers a flexible period of study varying between a minimum of 6 months to a maximum of 2 years for completion to suit the varied needs of the learners. All doctors, nurses and other workers with a minimum of high secondary school education are eligible to enroll.

The programme covers the following topics:

Course 1: Fundamentals – Environment and Health, HCWM Regulation

Block I *Understanding our Environment*
Block II *Healthcare Waste: Definitions*
Block III *Need for a Sound Healthcare Waste Management*
Block IV *Current Status of HCWM Legislation in SEAR Countries*

Course 2: Healthcare Waste Management: Concepts, Technologies and Training

Block I *Practical Aspects of Healthcare Waste Management*
Block II *Systems and Technologies in Healthcare Waste Management*
Block III *Healthcare Waste Management and Emerging Issues*
Block IV *Training Manual for Waste Handlers*
Project

Details on the programme is available online at http://www.ignou.ac.in/schools/sohs/chcwm.htm

Source: IGNOU, 2008

doctors to often school dropout low-level laborers. Raising awareness of the laborers working on healthcare waste as part of their daily routine is an important task and is the responsibility of the healthcare facility. Above Box presents a training programme conducted by the Indira Gandhi National Open University, India. The programme is offered under distance education mode in many Asian countries.

IFC REQUIREMENTS FOR HEALTHCARE PROJECTS

The International Finance Corporation (IFC) is a member of the World Bank Group and as the name implies the agency provides investments and advisory services to build the private sector in developing countries. IFC fosters sustainable economic growth in developing countries by financing private sector investment, mobilizing capital in the international financial markets, and providing advisory services to businesses and governments. IFC applies to all the projects it finances environmental and social standards to minimize their impact on the environment and on affected communities. In keeping its core values and care for the environment, IFC has developed a General Environmental Health and Safety Guidelines for various industrial sectors that it finances. The Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. A specific set of guidelines for healthcare facilities has also been developed (IFC, 2007). The following sections provide an overview of IFC requirements for healthcare facilities in terms of waste management.

According to the IFC, waste from healthcare facilities can be divided into two groups. The first consists of general waste, similar in composition to domestic waste, generated during administrative, housekeeping, and maintenance functions. The second group consists of specific categories of hazardous healthcare waste, as categorized by WHO. Healthcare facilities are required to establish, operate and maintain a healthcare waste management system (HWMS) adequate for the scale and type of activities and identified hazards. Facility operators should undertake regular assessment of waste generation quantities and categories to facilitate waste management planning, and investigate opportunities for waste minimization on a continuous basis. In addition to the guidance provided on solid and hazardous waste management in the General EHS Guidelines, the HWMS should include the following components:

Waste Minimization, Reuse, and Recycling

Facilities should consider practices and procedures to minimize waste generation, without sacrificing patient hygiene and safety considerations, including:

- Source reduction measures
- Waste toxicity reduction measures
- Use of efficient stock management practices and monitoring (e.g. for chemical and pharmaceutical stocks)
- Maximization of safe equipment reuse practices following sterilization and disinfection (e.g. sharps containers)

Waste Segregation Strategies

At the point of generation, waste should be identified and segregated. Non-hazardous waste, such as paper and cardboard, glass, aluminum and plastic, should be collected separately and recycled. Food waste should be segregated and composted. Infectious and / or hazardous wastes should be identified and segregated according to its category using a color-coding system. If different types of waste are mixed accidentally, waste should be treated as hazardous. Other segregation considerations include:

- Avoid mixing general healthcare waste with hazardous healthcare waste to reduce disposal cost
- Segregate waste containing mercury for special disposal
- Segregate waste with high content of heavy metals (e.g. cadmium, thallium, arsenic, lead) to avoid entry into wastewater streams
- Separate residual chemicals from containers and remove to proper disposal containers to reduce generation of contaminated wastewater.
- Different types of hazardous chemicals should not be mixed
- Establish procedures and mechanisms to provide for separate collection of urine, feces, blood, vomits, and other wastes from patients treated with genotoxic drugs. Such wastes are hazardous and should be treated accordingly
- Aerosol cans and other gas containers should be segregated to avoid disposal via incineration and related explosion hazard;
- Segregate healthcare products containing PVC to avoid disposal via incineration or in landfills.

On-site Handling, Collection, Transport and Storage

- Seal and replace waste bags and containers when they are approximately three quarters full. Full bags and containers should be replaced immediately
- Identify and label waste bags and containers properly prior to removal
- Transport waste to storage areas on designated trolleys / carts, which should be cleaned and disinfected regularly
- Waste storage areas should be located within the facility and sized to the quantities of waste generated, with the following design considerations
- Unless refrigerated storage is possible, storage times between generation and treatment of waste should not exceed the following
  - Temperate climate: 72 hours in winter, 48 hours in summer
  - Warm climate: 48 hours during cool season, 24 hours during hot season
- Store mercury separately in sealed and impermeable containers in a secure location
- Store cytotoxic waste separately from other waste in a secure location
- Store radioactive waste in containers to limit dispersion, and secure behind lead shields.

Transport to External Facilities

- Transport waste destined for off-site facilities according to the guidelines for transport of hazardous wastes / dangerous goods in the General Environmental Health and Safety Guidelines
- Transport packaging for infectious waste should include an inner, watertight layer of metal or plastic with a leak-proof seal. Outer packaging should be of adequate strength and capacity for the specific type and volume of waste
- Packaging containers for sharps should be puncture-proof
- Waste should be labeled appropriately, noting the substance class, packaging symbol (e.g. infectious waste, radioactive waste), waste category, mass / volume, place of origin within hospital, and final destination
- Transport vehicles should be dedicated to waste and the vehicle compartments carrying waste sealed

Treatment and Disposal Options

Facilities receiving hazardous healthcare waste should have all applicable permits and capacity to handle specific types of healthcare waste. Wastes from each category should be treated according to the prescribed treatment methods and technologies. When selecting a waste disposal technology, operators should consider other potential health and environmental issues that may be generated by the treatment. The main types of treatment and disposal technologies and techniques available for healthcare waste are described below:

Incineration is a high temperature dry oxidation process to reduce organic, combustible waste to significantly smaller quantities of inorganic, incombustible matter. Incineration may produce gaseous air emissions, ash residues, and wastewater. Depending on the amount of waste generated and the other factors, healthcare facilities may operate on-site incinerators, or waste may be transported to an off-site incineration facility. Incinerators should have permits to accept healthcare waste and be properly operated and maintained.

Chemical disinfection involves the addition of chemicals to kill pathogens in healthcare waste. Waste should be mechanically shredded prior to treatment. Treatment involves the use and handling of hazardous chemicals, in addition to disposal of hazardous residues following treatment.

Wet thermal treatment disinfects waste by exposing shredded waste to high temperatures / pressure steam inside an exposure tank. Wastewater discharges and odor may result. Autoclaving is a type of wet thermal disinfection process typically used to sterilize reusable medical equipment. Dry thermal disinfection involves the shredding, heating, and compacting waste in a rotating auger. Air emissions and wastewater may be generated, and residues require disposal.

Microwave irradiation involves the destruction of microorganisms through the microwave heating action of water contained within the waste. Following irradiation, waste is compacted and disposed of as part of the municipal waste stream. Contaminated wastewater may also be generated.

Land disposal involves the disposal of healthcare waste into landfill facilities. Properly designed and operated sanitary landfills will protect against air and groundwater contamination. Disposal of waste into open dumps is not considered good practice and should be avoided. Pretreatment of waste prior to land disposal may involve encapsulation (filling containers with waste and an immobilizing material and sealing the containers).

Inertization involves mixing waste with substances (e.g. cement) to minimize leaching of toxic waste into ground or surface water.

CONCLUSION

Evidently, healthcare waste management is a subject of concern among all developing member countries of the TWGSHW. Though some countries are ambitious about taking healthcare waste management progressively, they either lack knowledge, strategies, legislations, budgets or a mix of all. As mentioned in the earlier sections of this report, some simple management practices, presented in this chapter, when directly replicated with little modification to suit the local needs, can yield striking results. For example, the waste segregation at source and recycling initiatives of Hospital Lam Wah Ee, Malaysia provides an easily replicable model for any hospital of similar scale in any Asian country, given the commonality in waste composition and generation. Conversely, the recycling of used syringes in a hospital at Pakistan turns out to be a red alert for an inattentive case of healthcare waste disposal.

Technical difficulties in treatment are assumed to be complicated and deliberated to be the foremost obstacle in healthcare waste disposal. Real time examples where changes in collection and segregation of the waste have enormously reduced the amount of waste requiring ultimate treatment. A mere change in the practice with little or no investment could eventually result in a significant reduction in the final treatment cost, for example the case of hospitals in Europe provided earlier.

Healthcare waste management experiences in India, such as the Biomedical Waste Management Rules, biomedical waste management in the national capital Delhi and the training programme offered by IGNOU are all inspiring and open avenues for further regional collaboration and knowledge exchange.

Knowing very well, that the developing TWGSHW member countries are often faced with budget limitations, guidelines from IFC have been provided to present a picture of how investment agencies look at financing healthcare and healthcare waste management projects.

In essence, this chapter has been structured to provide a bird's eye view of healthcare waste happenings, not only in the region but across the world. The spirit of the chapter lies in understanding the factors that determine successful healthcare waste management through the few examples provided and replicating them in a national/local context without much reliance on external resources.

5

RECOMMENDATIONS

INTRODUCTION

Synthesizing the status of healthcare waste in the studied countries and with an understanding of the healthcare waste management practices in the region and across the world, this Chapter presents some key aspects to think over.

Guidelines for appropriate healthcare waste management are available in many forms and shapes and with the dawn of an information world it is not difficult to access them. In fact, formulating or finding guidelines for healthcare waste management is straightforward and not demanding at all. Workable strategies for realizing the guidelines in action are rather imperative.

Expel conventional intuitions of healthcare waste and impel fresh insights into minds of all concerned.

Healthcare waste management has been dialogued on a multitude of events in the last two decades. However, what have been mostly discussed are the technological issues in handling healthcare waste, treatment methods, secondary pollution problems and implementation of waste management plans. The following sections of this Chapter do not declare them redundant, but endeavors to supplement them with vibrant thoughts and dynamic perspectives to meet the changing priorities of the countries.

POINTS TO PONDER

Problem of Management not Technology

Healthcare waste has been mostly looked upon as technological issue and any debate on it begins with the accessibility or soundness of relevant technologies. Time and again, hi-tech incinerators are perceived to be the one-stop solution for disposing healthcare waste, regardless of what the constituents are. Environmentalists and pressure groups across the world have been raising hues and cries on the ramifications of incineration. It is vital to understand that incineration cannot single-handedly solve healthcare waste disposal issues. It is only the last link at the end of the healthcare waste chain, but with many other management measures before that.

Healthcare waste has to be seen as contiguous blocks of individual actions requiring appropriate management strategies to control it. Every block consists of specific tasks such as segregation at source, proper collection, safe storage, systematic transportation and sound disposal. It is essential to look through the composition of the waste and then select appropriate management strategies, first to avoid its generation, second to reduce the amount generated and thirdly to find a treatment method, barring incineration.

The primary step in healthcare waste disposal should be to evolve a management plan for the different components of the waste stream. Getting entrapped into complicated technologies requiring huge capital investments to dispose, what is called, waste would only result in throwing valuable resources down the drain.

A proper management plan that takes into account the contents of the waste, the quantities generated and the local socio-economic and industrial conditions would eventually be beneficial. A complex technology that turns the potential recyclables to ashes will not be so. However, management models to be adopted largely depend on the aspirations of governments and healthcare facilities.

Inclusive System, Not an Amalgam of Discrete Activities

Managing healthcare waste is an inclusive system comprising many important strategies requiring meticulous planning, adequate foresight, deep knowledge and especially, application of all these, to make the system function effectively. When planning for a healthcare waste management system, it is essential to understand the various components of the waste itself; the sources of generation, segregation options, the safe practices to be followed, where they could be relaxed and where tightened etc.

Understanding the constituents of the waste and their infectiousness is essential to choose what final treatment it should be exposed to. Mixing an infectious constituent to the non-infectious would render the whole stream infectious, thus pushing it to be treated with special care. The upshot of blemishes in one component and their reflections on subsequent components are of particular importance. Unlike discrete activities, where an error in one activity does not affect the other, all components of a healthcare waste management system have to operate in harmony with its succeeding component. Any slip seriously reflects on the subsequent operations.

Segregation, color coded collection, storage, transport and treatment are all components of the inclusive system and not just discrete activities. The design of components of the system has to be aligned with overall treatment options of all ingredients of the waste stream.

Look at the Opportunities Not only the Threats

Healthcare facilities and hospitals, like any other office, generate general waste that could be recycled, when properly segregated and handled. In addition, core medical treatment processes also generate some wastes that could be safely recycled, unless they are contaminated with infectious wastes. Such non-infectious wastes offer enormous potential for recycling. General wastes such as office paper, beverage cartons, soft-drink bottles, aluminium cans, packaging materials, styrofoam, plastics etc could be separately collected and sold for recycling. In the absence of a dedicated collection and recycling system, these wastes, with enormous potential for recycling, are likely to enter the healthcare waste stream and line up for specialized treatment, resulting in redundant waste disposal costs.

Conversely, a proper recycling system that includes visual screening of the materials, arising from areas that are likely to infect them, could be an unrivaled option to the conventional waste collection and disposal system. When properly implemented, with appropriate checks and balances, such a system could result in the creation of new jobs, for example, through a regional recycling centre processing the non-infectious portion of the healthcare waste stream. Such a recycling system saves costs and returns materials for further use without relying on virgin material which a complex technology for destruction of the waste would not be able to do.

The proceeds from the sale of recyclable wastes and the avoided treatment costs could be recursively invested in advancing the overall healthcare waste management system. Healthcare waste also offers opportunities to take advantage of, it is a not a threat solely.

Measure, if Not It Cannot Be Managed

"You Can't Manage What You Don't Measure" is a classical management axiom and has been repeatedly proved. Healthcare waste is a critical subject involving costs and consequences and unless it is measured, is not possible to ascertain if it is getting better or worse. Managing for improvement is not impossible if it is not measured to understand what is getting better and what isn't. To measure something, in general involves three central aspects:

- Measurement – The figure, extent, or amount obtained by measuring
- Metric - A standard of measurement
- Benchmark - A standard by which others may be measured

When talking about measurement, the questions that strike minds of healthcare waste stakeholder are what should be measured, why it should be measured and how. All healthcare waste after segregation, in a universally accepted manner, should be measured. Measurements should be recorded and stored for easy access to authorized personnel.

Standard procedures, following scientific methods have to be adopted for measuring and assumptions and auxiliary adjustments have to be clearly indicated. For example, when healthcare waste is measured, some country governments take into account the bed occupancy rate while some do not. In some countries, the overall country level healthcare waste, not considering segregation, is recorded and then converted to the specific values based on the bed count. It is here that metrics come into picture. Standard practices, reflecting top down approach of mathematically converting overall healthcare waste into specific values or bottom up approach by determining healthcare waste at hospital level and mathematically projecting to country data have to be established. Whatever, be the approach adopted, the metrics have to be clearly established and explained through proper documentation.

The next important feature in measurement is benchmarks, which are often referred to as industry wide standards, for example x kg/bed/day. Benchmarks are important in that they assist in monitoring the amount of waste that is generated and could help implement waste minimization programmes at healthcare facilities. When benchmarks are established, healthcare facilities willing to cut down on the waste generation will be able to monitor themselves and compare their performance with peer groups within the country, region or the whole world, of course taking into account the economic status. Benchmarks may not be the correct way of comparing waste generation levels between a developed and developing country. This has to be taken into account when using benchmarks.

A further extension of the measurements is establishing Key Performance Indicators which help healthcare facilities define and measure progress toward its goals. Displaying these Key Performance Indicators in prominent places within the healthcare facility premises will serve as an additional motivation to staff and provide a clear picture of how they contribute to overall improvement.

Reviewing metrics and using them to guide decisions is extremely important. With proper metrics in place, it is easy to analyze which strategies are working and which are not.

When region-wide metrics are established, then feasibility of technologies can be easily analyzed without much risk. For example, the viability of a particular technology to treat healthcare waste can be studied, and the results shared among others in the region, thus reducing the risks associated with the investments in new technologies.

When a Healthcare Waste Management System could Fail?

Healthcare waste is, definitely a subject requiring understanding of the intricacies, especially of the components of the waste. A high degree of judgment is required while segregating the waste. More importantly, it has to be informed-judgment. Barring the doctors and nurses, almost all healthcare facility staff are under-educated to make an informed-judgment while segregating and handling the waste. Their ignorance cannot be allowed to render the whole stream infectious. This can be classified into Deficiency of Knowledge and Deficiency of Execution (Jones and Martin, 2004).

In simple terms, Deficiency of Knowledge means not knowing what to do and Deficiency of Execution means not being able to do the way it has to be done. A typical example would be where a staff has to segregate the waste based on its infectious nature. Not knowing what criteria to use to make this judgment is Deficiency of Knowledge. Not being able to segregate, knowing very well the criteria is Deficiency of Execution.

In both cases training is required to overcome the deficiency. Some of the causes of deficiencies of execution include task interference, lack of feedback (employee does not know when the job is being performed correctly or incorrectly), and lack of awareness on the gravity of consequences.

The approach or the method of training may differ, however. Deficiencies of Knowledge can be corrected by training the employee to do the job, then observing and correcting as necessary until the task is proficiently performed. Deficiency of Execution is usually corrected by searching for the underlying cause of lack of performance, not by teaching the actual task. Some basic training that healthcare facility staff should undergo, in the context of waste management is:

- Knowledge Training about different waste streams, their infectiousness, and the intensity of consequences if not correctly handled etc
- Skills Training on procedures to be followed to prevent injuries to self and others while handling infectious healthcare waste, emergency response in case of spills, occupational health and safety etc
- Attitude Guidance on approaching non-infectious waste as a resource for recycling, team working with counterparts in organizing recycling schemes within the facility

ROLE OF STAKEHOLDERS

Managing the various and interdependent facets of healthcare waste at the facilities involves both internal stakeholders such as all levels of staff, as well as patients and care takers and external stakeholders such as the government, policymakers, law enforcement authorities, waste management service providers and academia. Figure below provides an overview of the roles of stakeholders. There should be clearly identified responsibilities with the authority and resources required to carry out steps involved in proper healthcare waste management. However, the level of participation described below is achievable only through the allocation of resources and commitment at all levels. Besides, effective relations between different government sectors, and between the public sector, the private sector and local communities, are essential to carryout effective and efficient healthcare waste management in healthcare facilities.

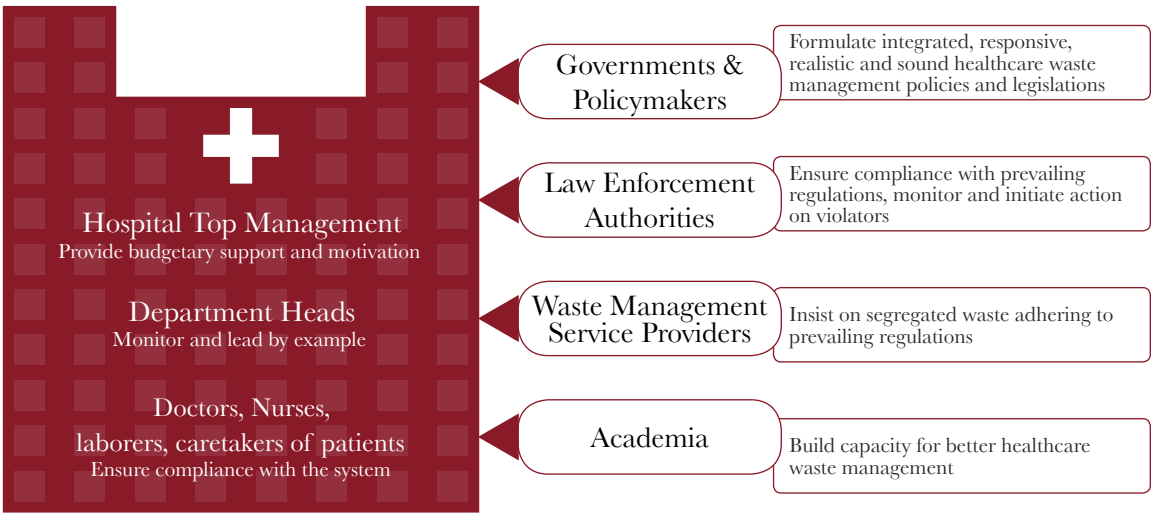
Internal Stakeholders

The internal stakeholder group mainly consists of hospital top management, department heads and doctors, nurses, laborers and care takers of patients. The roles of these stakeholders are briefly described below.

Hospital top management

Before the implementation of an action plan for healthcare waste management, commitment and responsibility must be delegated to the staff in the healthcare facility. This should be carried out by the hospital top management through appropriate motivation. Further, allocating sufficient financial and human resources to ensure efficient operation of the plan are roles of top management.

Role of Stakeholders



Department heads

Department heads are responsible for the segregation, storage, and disposal of waste generated in their departments. They should ensure that all doctors, nurses, and clinical and non-clinical professional staff in respective departments are aware of the segregation and storage procedures. Further, to assist the staff of the department to liaise to monitor the standard working procedures and to train key staff members in waste segregation and disposal procedures. Besides, department heads have the responsibility to encourage medical and nursing staff to be cautious so as to ensure that secondary staff follow correct procedures at all times.

Doctors, nurses, laborers, care takers of patients

The roles of doctors, nurses, laborers, care takers of patients include following the correct procedures for segregation, storage, transport, and disposal of waste and maintaining highest standards in healthcare waste management. Further, nurses and laborers should participate in continuous training on handling and disposal of waste and other waste management issues specific to the departments. Care takers of patients should comply with the waste management practices of the facility and cooperate with them.

External stakeholders

The success of the healthcare waste management depends on not only the internal stakeholder participation but also external stakeholder commitment and participation. The roles of the external stakeholders are briefly described below.

Government and policymakers

The role of policymakers is to formulate integrated, responsive, realistic and sound healthcare waste management policies and legislations to address the healthcare waste in an appropriate manner. Further, the government is responsible for developing a framework for the controlled disposal of HCW and to ensure that healthcare centers to share the responsibility to manage wastes appropriately.

Law enforcement authorities

These authorities have the responsibility to ensure compliance with prevailing regulations, to monitor and initiate action against violators. The gradual implementation of the law enforcement by the authorities is recommended in preference to introduce all measures simultaneously, particularly where existing practices are inadequate.

Waste management service providers

The service providers for waste disposal should insist on segregation of waste adhering to prevailing regulations. Further, they should ensure the correct segregation of waste at the point of generation by clear identification of the different categories of waste. The service providers for waste disposal should insist on segregation of waste adhering to prevailing regulations

Academia

The academia has the duty to build capacity at academic level for better healthcare waste management. This will enhance the awareness concerning the proper healthcare waste management and its importance among the communities.

Stakeholder Group	Role in Healthcare Waste Management
Patients	Cooperate in complying with practices of healthcare waste management and where possible insist care takers to do so
Patients' families and care takers	Cooperate in complying with practices of healthcare waste management and where possible insist nurses and laborers to do so
Healthcare workers	Carry out disease prevention duties (such as cleaning, healthcare waste management) consistently and well Follow rules for healthcare waste segregation Inform patients and care takers about in-house practices on waste management Cooperate with management and participate actively in achieving and maintaining waste minimization targets
Healthcare facility managers	Plan and implement healthcare waste management programmes to set, achieve, monitor and maintain targets. Create incentives for staff and motivate them to meet and maintain targets Cooperate with top management, convince them and obtain support for healthcare waste management and recycling activities
Health authorities	Provide resources and direction for setting, achieving and maintaining healthcare waste reduction targets Publicize good practices of healthcare waste management and arrange for guidance visits for poor-performing hospitals Coordinate peer group meetings to share results of better healthcare waste management practices
Academia	Raise awareness in medical schools and other sectors. Provide training for the health sector.
Policymakers	Provide and mobilize political and financial support for improvements.
National and funding bodies international	Provide funding for new healthcare waste management programmes

KEY RECOMMENDATIONS

As mentioned in the earlier sections of this report, this study has been conducted at a regional level, taking into account the national variations and trends of healthcare waste generation, methods of characterization, approaches in collection and segregation, differences in treatment and disposal. Overall, a general lack of universality between countries prevails, thus preventing country specific recommendations. However, it could be established that the overall condition of healthcare waste warrants immediate attention and action. A synthesis of information from all the 12 countries evidently illustrates three key areas for immediate action and is presented in the Figure (next page), in the order of importance.

Healthcare waste has many problems associated and a compulsion to find appropriate solutions either through management strategies or technological interventions exists. The mounting quantities of waste generated reflect the advances in our healthcare systems, facilities and priorities. Undeniably, a rapid upgrade of our healthcare waste management strategies is vital to cope up with this increase and keep a safer environment. Healthcare waste spans across a wide spectrum from benign recyclables to infectious needles, requiring a perfect blend of management strategies and technologies to handle them. Though the ratio of infectious to non-infectious waste is in the order of 1:10, a small slip could make the entire waste infectious, thus costing more efforts and resources. Well formulated waste minimization strategies, fact-based segregation of healthcare waste and knowledge and skill oriented training of healthcare staff form the linchpin of an attentive healthcare waste management system. A perfect healthcare waste system should consist of

- National legal framework exclusively for healthcare waste – not part of other frameworks
- Clearly defined roles and responsibilities through devoted departments and officials
- System to ensure accountability and transparency in healthcare waste management - healthcare facility and government
- Healthcare waste segregation system based on WHO guidelines
- System for complete material recycling and treatment facility, exclusively for infectious waste
- Regular capacity building, training and awareness programmes

BUDGET

National Government

Fiscal incentives for performing hospitals are best ways to encourage HCWM with low cost

Encourage centralized treatment facilities under Build, Operate, Transfer / Build, Own, Operate, Transfer

Adopt clustering of healthcare facilities to share costs

Healthcare facility

Choose a low-cost waste management plan and implement it

Institutionalize a recycling system and use the proceeds to recursively fund the overall healthcare waste management system

POLICIES & LEGISLATIONS

National Government

Formulate healthcare waste policy and legislations considering other countries' experiences and local needs

Assign clear responsibilities and create dedicated departments for monitoring and overseeing healthcare waste management.

2

Healthcare facility

Healthcare waste management should not be contingent upon law or regulation; it should come out of duty of care

A healthcare facility-level policy on HCWM should be the correct start

Cooperate with national government through proactive, rather than hindering, inputs

clear assignment of waste management responsibilities to personnel

1

TECHNOLOGY & KNOWLEDGE MANAGEMENT

National Government

Build capacity of relevant department staff on:

- technical and management topics for HCWM
- implementation of HCWM plans
- monitoring of HCWM plans
- safe and sustainable HCWM technology selection
- management of HCWM technologies

Healthcare facility

Raise awareness of staff in handling, safety and exposure to HCW

Conduct periodic induction trainings for new staff and updates for existing staff

Monitor and evaluate waste management activities and their impact

Track the progress of HCWM and report the successes and reward staff

3

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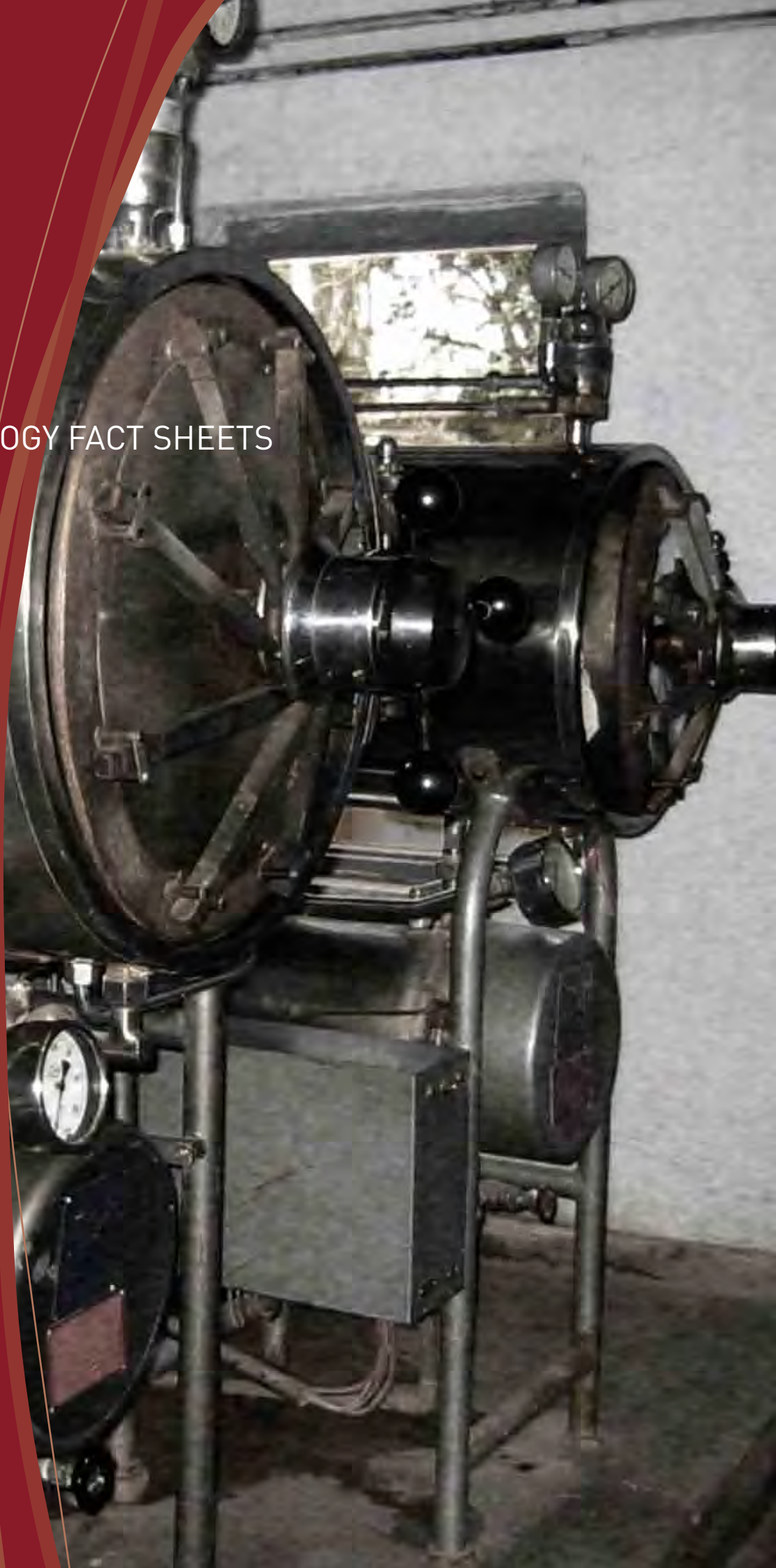
TECHNOLOGY FACT SHEETS



INTRODUCTION

In the early 1990s, when healthcare waste as an issue was required to be addressed, incinerators were perceived to be the right solution. However, in the recent years the reality behind incinerators has been uncovered to a large extent and identified them as a problematic technology for treatment of healthcare waste. It was at this period that the flipside of incineration, as a process that changes the waste not just physically but also chemically, drew the attention of environmentalists and public alike. The end products, air borne chemical pollutants and ashes, were be more toxic than the waste and the need to dispose them appropriately to avoid environmental and human health hazards was realized. Simultaneously, non-burn technologies aiming and eliminating the toxicity causing materials evolved.

Various technologies are now available for the treatment of healthcare waste and can be categorized as: Thermal processes using low heat, medium heat, high heat; Chemical processes; Irradiative processes; and Biological processes. This section provides information on alternative technologies available to assist hospital administrators, healthcare professionals, policy makers, and the community for disposal of healthcare waste.

Note: This section does not endorse any specific technology or company. This fact sheet is presented only with the objective of illustrating some of the available technologies and as an example of non-incineration treatment methods available. The onus of identifying and selecting the appropriate technology remains with the respective user. It is highly recommended to check for the latest and most accurate data and specifications with the technology vendor.

AUTOCLAVING

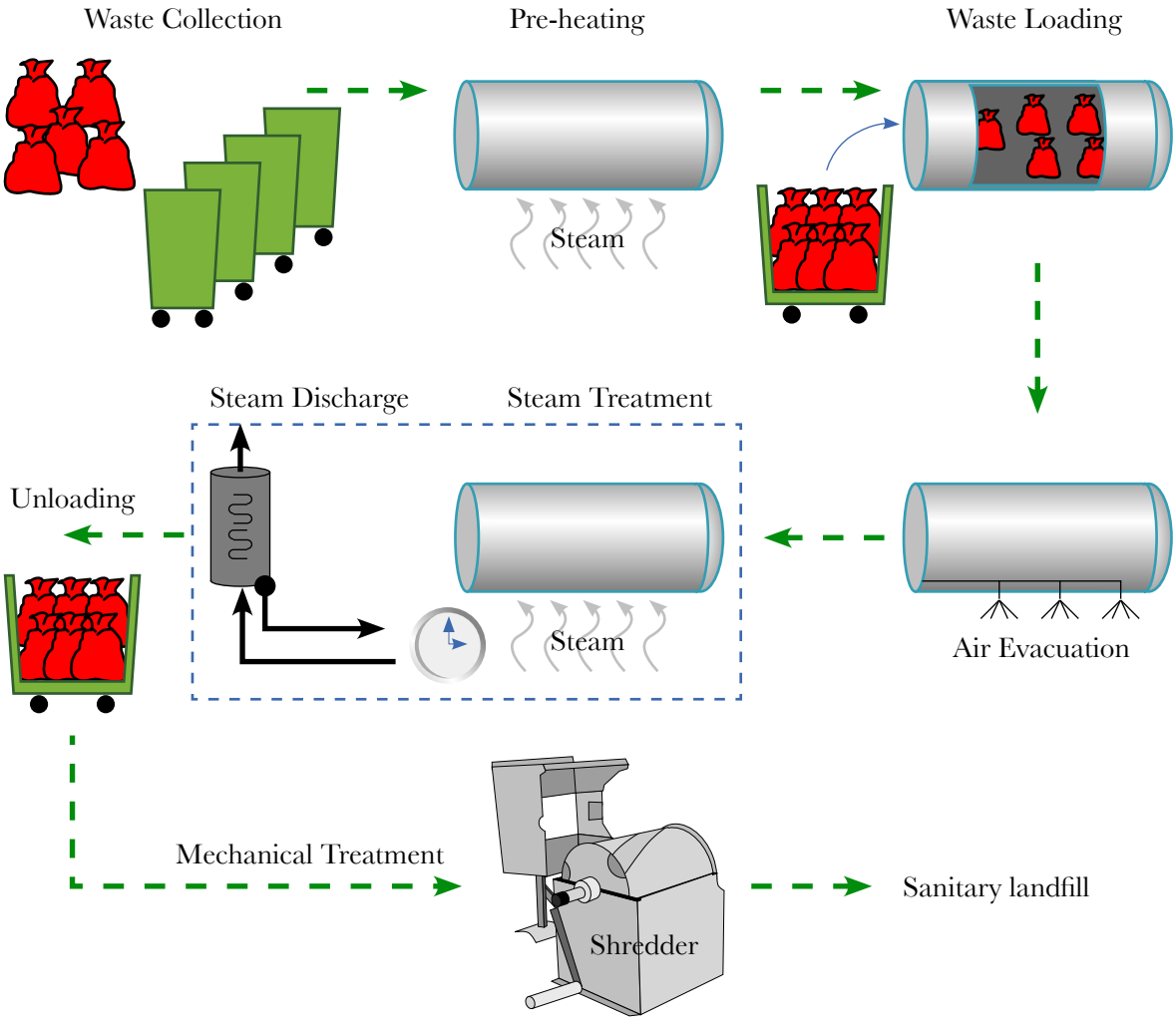
What is an autoclave?

Autoclaving is the process of steam disinfection wherein, the waste is exposed to steam at high pressure and temperature to decontaminate the infectious waste. Autoclaves are found in research, diagnostic and microbiology laboratories, health centers and other places that require high-level disinfection. An autoclave consists of a metal chamber sealed by a charging door and surrounded by a steam jacket.

What can be autoclaved?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Flammable, reactive, corrosive, toxic or radioactive	✗

How does an autoclave work?



What are the other Steam Based Systems available?

Recently, a second generation of steam based systems have been developed for the purpose of improving heat transfer with the waste, thus achieving more uniform heating of the waste, rendering the waste unrecognizable, and making the treatment system a continuous process rather than a batch process. These new generations of steam based systems are referred as advanced autoclaves. The function of these systems are similar to autoclaves however, the process of other steam based systems combine steam treatment with pre-vacuuming and various kinds of mechanical processing before, during, and/or after steam disinfection.

The combinations include:

- Vacuum / steam treatment / compaction
- Steam treatment-mixing-fragmenting / drying / shredding
- Shredding / steam treatment-mixing / drying (and chemical cleaning)
- Shredding-steam treatment-mixing / drying
- Steam treatment-mixing-fragmenting / drying
- Pre-shredding / stream treatment-mixing

	Vendor	Capacity	Technology Presence
Low-Heat Technologies			
AUTOCLAVES	Bontech www.bondtech.net elsabrown@earthlink.net	115 -2727 kg/cycle	USA., Canada, Korea, UK, China, Pakistan, Australia
	Environmental Tectonics Corporation www.etcusa.cominfo@etcusa.com	1815 -5900 kg/day	USA, Japan, Egypt, Thailand, UK, Singapore
	Mark-Costello www.mark-costello.com	102; 204; 256; 340; 510; 1361 kg/cycle	USA
	Sierra Industries www.sierraindustries.com sierra@sierraindustries.com	90, 226, & 340 kg/h	N/A
	Tuttnauer www.tuttnauer.com infor@tuttnauer.com	Up to 680 kg/h	Africa, France, UK, Asia, Australia, Middle East, South East Asia, USA

		Vendor	Capacity	Technology Presence
Low-Heat Technologies				
OTHER STEAM-BASED SYSTEMS	Vacuum/Steam Treatment/ Compaction	San-I-Pak www.sanipak.com sanipak@sanipak.com	11 – 1016 kg/h	USA
	Steam treatment-mixing fragmenting/ drying/shredding	Tempico Rotoclave www.tempico.com tempico@tempico.com	136 – 340 kg/h per vessel	USA
	Shredding/Steam Treatment-Mixing/ Drying and Chemical Cleaning	Sterile Technologies Industries, www.sterilebarrier.org chemclav@aol.com	272 , 454, 907, 1360, 1815 kg/h	N/A
	Shredding-Steam Treatment-Mixing/Drying	Redbag solutions www.redbag.com info@redbag.com	68 kg/h	N/A
		Ecolotec tmiken@mindspring. com	136 kg/h or more	Kuwait, USA
	Steam Treatment-Mixing-Fragmenting/Drying	Hydroclave Systems Corporation, www.hydroclave.com hydrosys@istar.ca	11-907 kg/h	Argentina, China, Egypt, Greece, India, Iran, USA, Lebanon, UK, Mexico, Philippines
	Pre-shredding/Steam Treatment-Mixing	Aegis Bio-Systems jrayburn@aegisco.com dtaylor@aegisco.com	min 608 kg/h	USA
	Shredding/Steam Treatment Mixing-Compaction	Goldner	150-200 kg/h	N/A

DIELECTRIC HEATING

What is a dielectric heating System?

This technology uses a heating process based on electro-thermal deactivation. Electromagnetic radiation is induced in the form of a microwave or radio wave frequency source with high frequency dielectric heating to treat the wastes.

	Vendor
Low-Heat Technologies	
DIELECTRIC HEATING	Stericycle, Inc. www.stericycle.com

Capacity	Technology Presence
454 – 2722 kg/h	Canada, Mexico, Puerto Rico, USA

	Vendor
Low-Heat Technologies	
MICROWAVE SYSTEMS	Sanitec www.acce-sanitec.com mwood@acce-sanitec.com

Capacity	Technology Presence
99- 181; 249-408 kg/h	Brazil, Canada, Japan, UK, USA, Philippines, Saudi Arabia, South Korea

MICROWAVE SYSTEMS

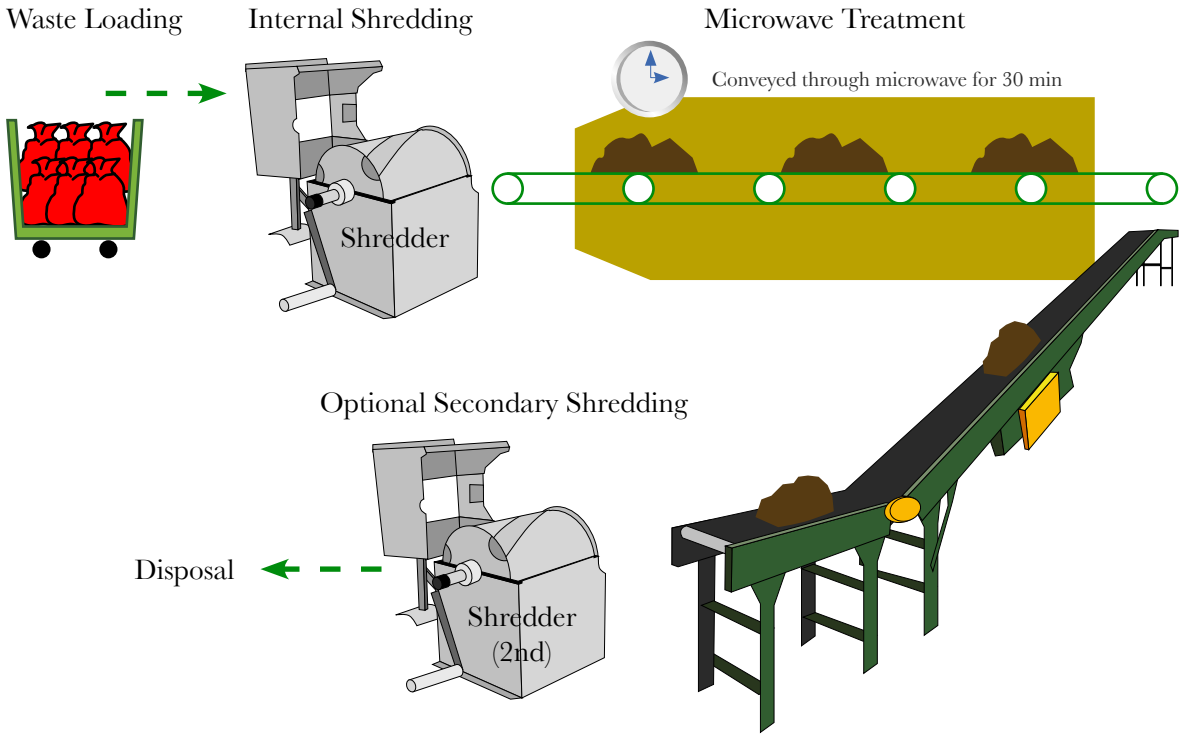
What is a Microwave System?

Microwave disinfection is a steam-based process, where steam is generated by microwave energy to disinfect the waste through the action of moist heat and microwave. The waves of microwave energy circulate at very high frequency. This causes water and other molecules in the waste to pulsate rapidly as they try to align themselves to the electromagnetic field. The forceful vibration creates friction, which, in turn, generates heat, turning water into steam. The heat denatures proteins within microbial cells, thereby inactivating the pathogens in the waste. Hence, microwave technology is an effective disinfection system.

What can be microwaved ?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Human anatomical wastes	✓
Volatile and semi-volatile organic compounds	✗
Bulk chemotherapeutic wastes	✗
Mercury and other hazardous chemical wastes	✗
Radiological wastes	✗

How does a microwave system work?



HIGH VELOCITY HEATED AIR

What is a high velocity heated air system?

In this system heat is applied without adding steam or water. Instead, the waste is heated by conduction, natural or forced convection, and/or by thermal radiation. The heart of the system is an air-tight stainless steel chamber into which shredded healthcare waste is introduced and exposed to high velocity heated air pumped into the bottom of the chamber. Hot air is directed in a way that causes the waste particles to rotate turbulently.

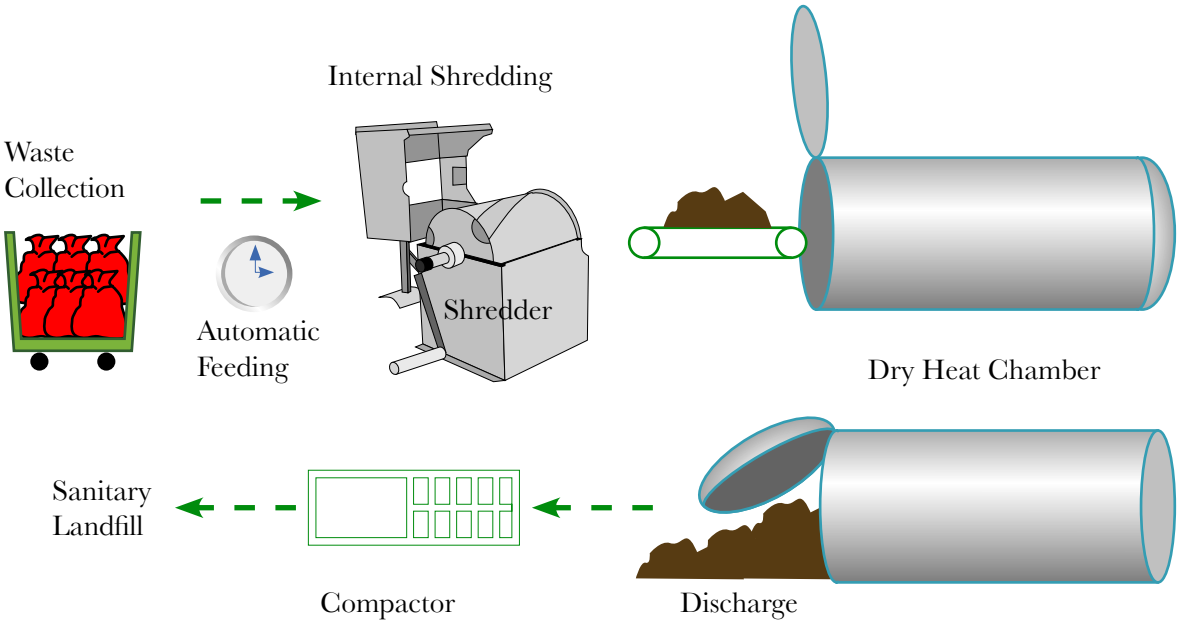
	Vendor
Low-Heat Thermal Technologies: Dry-Heat Systems	
HIGH VELOCITY HEATED AIR	KC Mediwaste

Capacity	Technology Presence
91kg/h	USA

What can be treated with high velocity heated air?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
liquids such as blood and body fluids	✓
Human anatomical wastes	✓
Volatile and semi-volatile organic compounds	✗
Bulk chemotherapeutic wastes	✗
Mercury and other hazardous chemical wastes	✗
Radiological wastes	✗

How does a high velocity heated air system work?



DRY HEATING

What is a dry heating system?

The concept of dry heat system is similar to the High Velocity Heated Air system where waste is heated by conduction, natural or forced convection, and/or by thermal radiation. Dry-heat processes use higher temperatures and longer exposure times than steam-based processes but the time-temperature requirements actually depend on the properties and size of the wastes being treated.

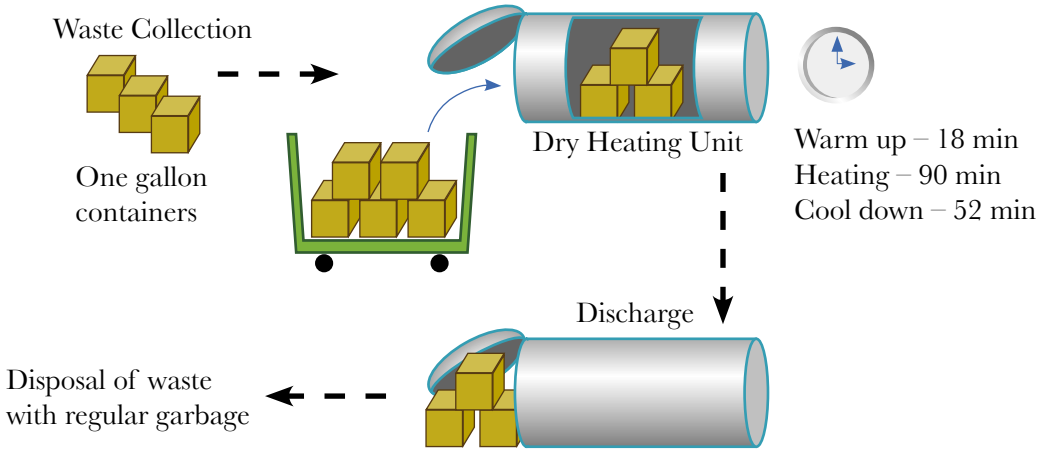
	Vendor
Low-Heat Thermal Technologies: Dry-Heat Systems	
DRY HEATING	Thermal Waste Technologies, Inc.

Capacity	Technology Presence
up to 3.8 litre/cycle	N/A

What can be treated with dry heating?

Type of waste	Suitability
Sharps	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Small amount of liquids such as dressing soaked with blood and body fluids	✓
Human anatomical wastes	✗
Volatile and semi-volatile organic compounds	✗
Bulk chemotherapeutic wastes	✗
Mercury and other hazardous chemical wastes	✗
Radiological wastes	✗

How does a dry heating system work?



DEPOLYMERIZATION

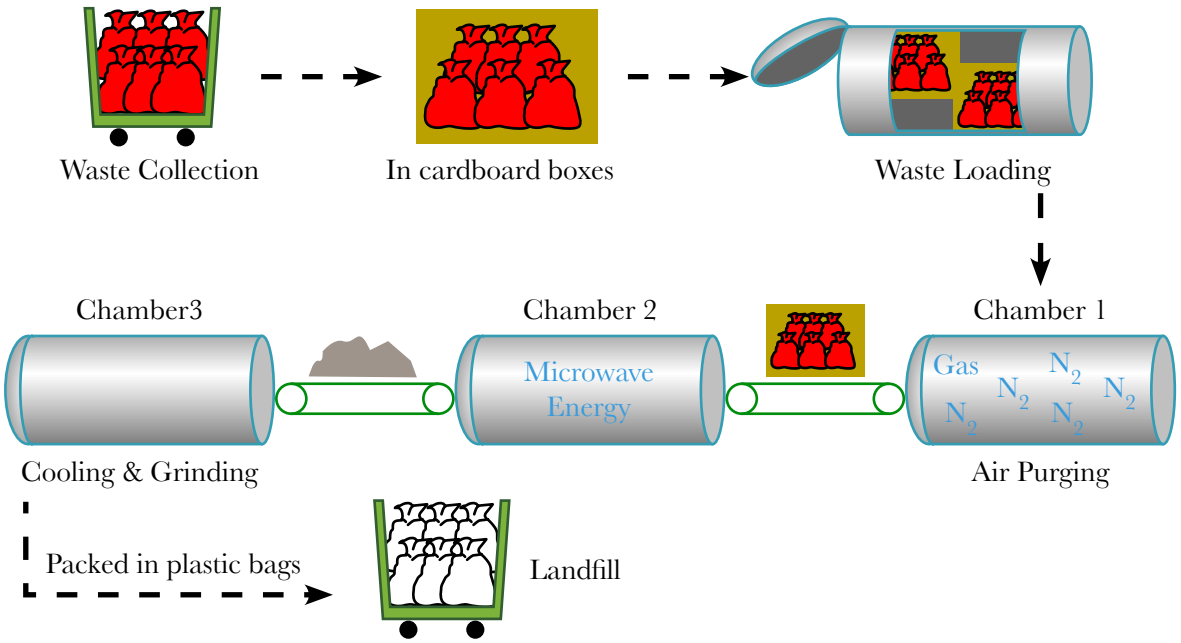
What is a depolymerization system?

Deplymerization directly applies high-energy microwaves to healthcare waste in a natural gas atmosphere to break down the organic material. Unlike other microwave systems that heat the waste to nearly 100°C, this system operates at temperatures high enough to cause chemical changes.

What can be treated with depolymerization?

Type of waste	Suitability
Biological & anatomical waste	✓
Needles	✓
Sharps	✓
Plastics & glass	✓
Other infectious waste	✓

How does a dry heating system work?



	Vendor	Capacity	Technology Presence
Medium- and High-Heat Thermal Technologies			
DEPOLYMERIZA TION	Environmental Waste International www.ewmc.com sales@ewmc.com	1225 kg/day	N/A

PYROLYSIS-OXIDATION

What is a pyrolysis-oxidation system?

This technology causes organic solids and liquids to vaporize, leaving behind an inert ash including inorganic material such as glass and metal fragments. Vapors are drawn by an induced draft fan from the pyrolysis chamber into a two-stage oxidation chamber operating at high temperatures. Controlled amounts of oxygen are added in the oxidation chamber to complete the combustion process.

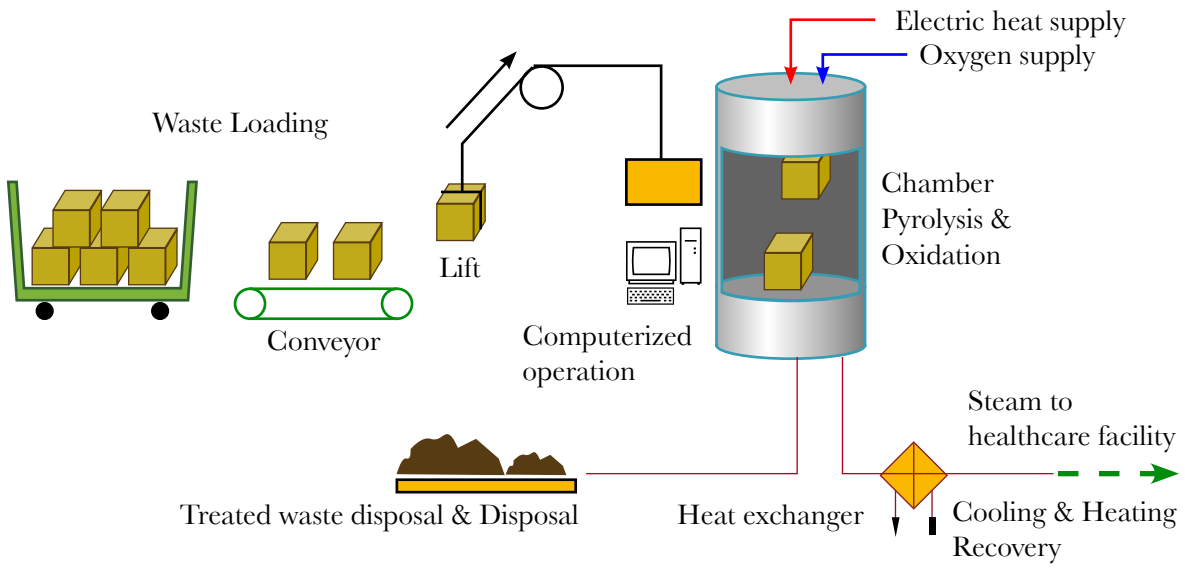
	Vendor
Medium- and High-Heat Thermal Technologies	
PYROLYSIS-OXIDATION	Oxidation Technologies, Inc., www.oxid-tech.com sales@oxid-tech.com

Capacity	Technology Presence
45 - 57; 454 - 680 kg/h	N/A

What can be treated with pyrolysis-oxidation?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Liquids such as blood and body fluids	✓
Pathological waste	✓
Animal waste	✓
Dialysis waste	✓
Bulk chemotherapeutic waste	✓
Pharmaceutical waste	✓
Radiological waste	✗
Waste contaminated with mecury	✗

How does a dry heating system work?



	Vendor
Medium- and High-Heat Thermal Technologies	
INDUCTION BASED PYROLYSIS	Vanish Technologies Joanne.jaeger@lfr.com

Capacity	Technology Presence
127 kg/h	N/A

PLASMA BASED PYROLYSIS

What is plasma based pyrolysis system?

The term plasma used in healthcare waste treatment is a physical state of matter comprised of ionized particles such as electrons and charged ions. In the plasma state, the ionized gas can conduct electric current, but due to its high resistance, the electric energy is converted to heat.

What can be treated with plasma based pyrolysis?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Liquids such as blood and body fluids	✓
Pathological waste	✓
Plastic waste	✓
Animal waste	✓
Residue chemotherapeutic waste	✓
Dialysis waste	✓

	Vendor	Capacity	Technology Presence
Medium- and High-Heat Thermal Technologies			
PLASMA-BASED PYROLYSIS SYSTEMS	Integrated Environmental Technologies www.inentec.com info@inentec.com	½, 1, 2, 4, 10 ton /day	N/A
	Bio Arc www.bioarc.com	181 kg/h	N/A
	Prometron Technics Corporation, Japan	90 kg/h	N/A
	Electro-Pyrolysis, Inc. Svedala Industries, Inc.,	340 kg/h	N/A
	HI Disposal Systems www.hawkinsindustries.com mr@donhawkins.com	1360 kg/h 33 Mg/day	N/A
	MSE Technology Applications, Inc.	159 kg/h	N/A

IRRADIATION TECHNOLOGIES

What is irradiation technology?

Irradiation is an electron beam technology which is highly automated and computer controlled. This technology requires shredders or other mechanical device in the post-processing stage to render the waste and reduce waste volume.

What can be treated with irradiation technology?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Volatile and semi-volatile organic compounds	×
Chemotherapeutic wastes	×
Mercury, other hazardous chemical wastes	×
Radiological wastes	×

	Vendor
IRRADIATION TECHNOLOGIES	BioSterile Technology www.biosterile.com

Capacity	Technology Presence
181 - 249 kg/ h	N/A

CHEMICAL BASED TECHNOLOGIES

What is chemical based technology?

Chemical based treatment technology can be divided in to Chlorine based and Non-chlorine based systems. Chlorine based system uses either sodium hypochlorite or chlorine oxide while the non-chlorine based system uses ozone/alkali liquid/dry chemicals (calcium oxide).

What can be treated with chemical based technology?

Type of waste	Suitability
Cultures & stocks	✓
Sharps	✓
Materials contaminated with blood & limited amounts of fluids	✓
Isolation & surgery wastes	✓
Laboratory wastes (excluding chemical waste)	✓
Soft wastes (gauze, bandages, drapes, gowns, bedding, etc.)	✓
Human anatomical waste	–
Volatile and semi-volatile organic compounds	×
Chemotherapeutic wastes	×
Mercury, other hazardous chemical wastes	×
Radiological wastes	×

	Vendor	Capacity	Technology Presence
Chemical-Based Technologies			
CHLORINE-BASED SYSTEMS	Circle Medical Products	Up to 1360 kg /h	N/A
	MedWaste Technologies Corporation www.medwastetech.com	N/A	N/A
NON-CHLORINE TECHNOLOGIES	Steris EcoCycle 10 www.steris.com	N/A	N/A
	Waste Reduction By Waste Reduction, Inc. www.wr2.net wr2@wr2.net	23, 91, 340, 682, 1364, 3,200 kg	Africa, Europe, Middle East, UK, USA
	Lynntech www.lynntech.com	100 – 235 kg/ batch	N/A

BIOLOGICAL SYSTEMS & SHARPS TREATMENT UNITS

Biological systems use an enzyme mixture to decontaminate healthcare waste and the resulting sludge is passed through an extruder to expel the water. The technology is suited for large applications (10 tons/day).

	Vendor	Capacity	Installation requirement	Technology Presence
Biological and Sharps Treatment Systems				
BIOLOGICAL SYSTEMS	Bio Conversion Technologies Inc	10 tons/day	N/A	N/A
SMALL SHARPS-TREATMENT UNITS	Sharpx Needle Destruction Unit www.biodisposal.com info@biodisposal.com	Destroys 18-30-gauge needles _ - 2" in length	N/A	N/A

Korea

The Korean Peninsula is situated at the eastern end of the Asian continent extending about 1,100 km long. China lies across the Yellow Sea to the west, while Japan is across the East Sea to the east. The Republic of Korea belongs to the temperate zone with four distinct seasons. The country has a presidential system with national assembly and is administratively divided into 16 higher-level local governments and 230 lower-level local governments. Nowadays, the local governments are the main provider of administration services for the citizens.

HEALTHCARE FACILITIES

Waste Management Act specifies 16 healthcare waste generators. The main sources of healthcare waste are hospitals and clinics. As of December 2007, there were 316 general hospitals and 50,123 clinics. Other generators of healthcare waste include public healthcare centers, veterinary clinics, research institutes for medicine and pharmacy, and so on.

Healthcare Facilities in Korea

Type of Healthcare Facilities	No. of Healthcare Facilities
General hospital	1,679
Clinics	2,757
Public healthcare center	2,962
Veterinary clinics	50,123
Others	316
Total	**57,837**

MANAGEMENT OF HEALTHCARE WASTE

According to Waste Management Act, healthcare wastes are defined as "Wastes that may threat human health by infection and, thus, need special treatment for the protection of human health and environment, which include human organs, animal bodies for clinical test, etc., generated from health and medical institutes, animal hospitals and other experiment and test institutes.

In Korea, healthcare waste is categorized under specified waste (similar to hazardous waste in other countries). Waste Management Act has included 7 types of healthcare wastes, which are classified according to the degree of hazardousness. Non-infectious wastes generated from healthcare waste facilities are defined as industrial wastes, but are able to be disposed as municipal wastes if the municipality allows.

Year	Healthcare waste Generation (tonnes/year)
2004	43,127
2005	59,056
2006	56,616
2007	82,633

Classification of Healthcare Waste

Healthcare Waste		Definition
Isolated waste		Wastes from the patients separated in order to protect people from infectious disease
Harmful waste	Organs	Human or animal tissues, organs, parts of bodies, dead animal, blood, pus, materials from blood
	Pathological waste	Culture fluids, culture fluid containers, waste test tube, slide, cover glass, etc., used for test and experiment
	Sharps	Syringe needles, blades for operation, needles for acupuncture, dental needles, broken glass test equipments
	Biological & Chemical waste	Waste vaccine, waste anti-cancer medicine, biological treating materials
	Blood-contaminated waste	Waste blood bags, waste for blood dialysis, and other blood-containing wastes
General waste		Cottons, bandages, gauze, disposable diapers, sanitary towels, disposable syringes, etc

Collection, Storage and Transportation

The generators are to keep healthcare wastes in the designated container as soon as they are generated. The designated containers include two types; envelope-type and box-type. The former are made of plastic and the latter is of corrugated cardboard or plastic (PVC is excluded). Before distribution, the producer of container should pass the test, which is carried out by the institutes authorized by Ministry of Environment (MoE) and carried out in accordance with the related standards set by MoE.

Envelope-type plastic container

Box-type cardboard container

Box-type plastic container

Healthcare waste collection in Korea

Healthcare wastes are to be contained in envelope-type plastic container or corrugated box-type cardboard container, whereas liquid waste, sharps, isolated waste and organs should be disposed in box-type plastic container. The generators should put envelope-type plastic container in the box-type container when they consigned the healthcare wastes to the treatment companies. The container should be in white color and include healthcare waste symbol with different colors depending on the healthcare waste type.

Color coding of healthcare waste

Type of waste	Color coding
Placenta	Green
Isolated Waste	Red
Harmful Waste	Yellow
General Waste	Black

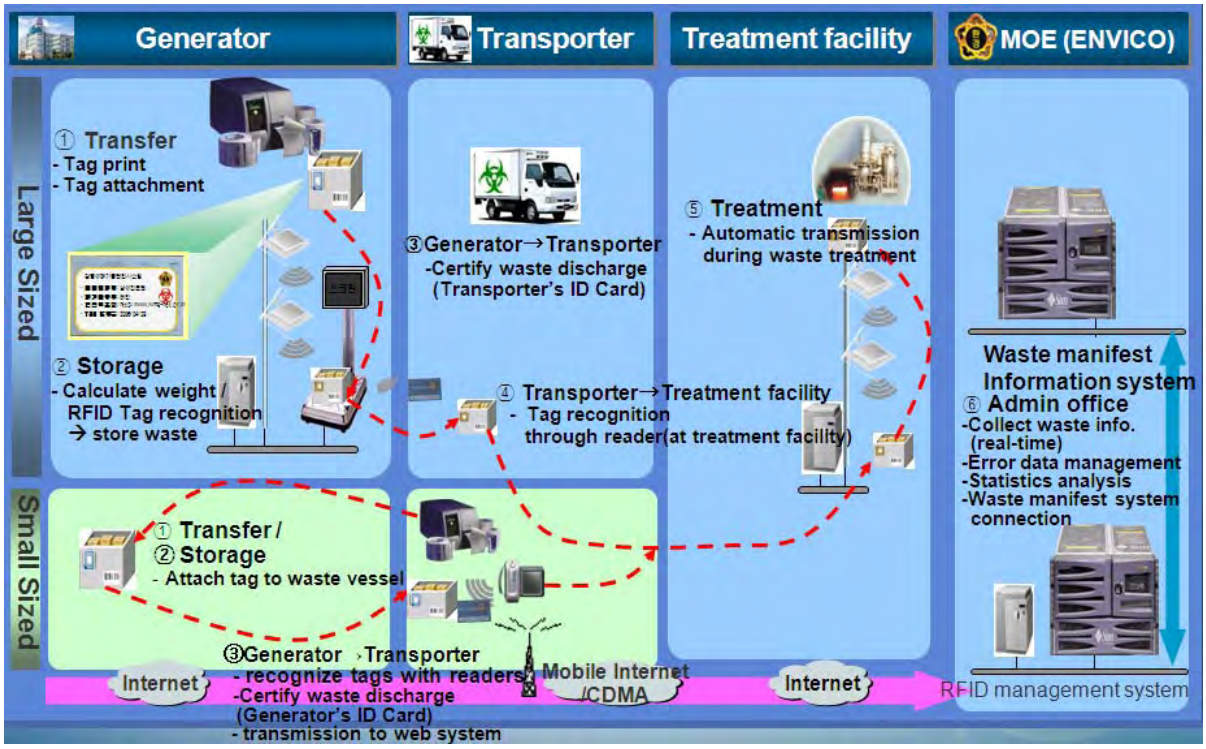
The transporter should keep the vehicle at 4°C or lower when it delivers healthcare wastes. The transportation vehicle should be white color and indicate the name of transporter, phone number and healthcare waste symbol in green color outside the vehicle.

Treatment and Disposal

The generators are responsible for the proper disposal of healthcare waste. In Korea, most of the healthcare wastes are consigned to the waste treatment companies, which get licenses for business from the regional office of MoE. Only incineration is allowed for the healthcare waste treatment companies. And the incinerator should be operated at 850°C or higher.

As of December 2007, 14 treatment companies were under operation in Korea. When the generators want to dispose healthcare wastes by themselves, they can run incinerator or sterilizer and crusher with permission from the authority; a regional office of MoE for general hospitals, municipality for other generators.

From August 2008, Korea has started a new manifest system to monitor the carriage and treatment of healthcare waste, which uses the RFID (Radio Frequency Identification) technology. In this new manifest system, the generator has to put an electronic tag containing such information as the type of healthcare waste, generator, weight, and etc. on the container. The transporter and disposers detect the information using RFID reader during carriage and treatment and send it on a real time basis to Korea Environment & Resources Corporation (ENVICO), an affiliate under MoE responsible for running waste manifest system. The RFID-based manifest system has many advantages over the previous paper-based manifest system. For example, it can prevent the illegal dumping during transportation utilizing the real-time monitoring. And also, it releases generator, transporter and disposer from producing a huge amount of papers, which are required for reporting the disposal of healthcare waste. The work process of RFID-based manifest system is presented below.



INSTITUTIONAL ANALYSIS

MoE is the competent authority for healthcare waste management in Korea. MoE establishes the national plan and a strategy for healthcare waste management, and develops regulations and guidelines. Waste Resources Management Division in Resources Recirculation Bureau is directly responsible for dealing with healthcare waste management in MoE.

Six regional offices of MoE and the municipality are executing the regulations and guidelines established by MoE. The main task of two institutional bodies is inspection and licensing on medical waste generators and consignees (transporter and treatment companies). The regional offices of MoE cover the general hospitals among generators, the transporters and treatment companies, and the municipality does other generators than general hospitals.

POLICIES AND LEGISLATION

Originally, the task of administering healthcare waste had been covered by Ministry of Health since 1981, and transferred to MoE in 2001. Waste Management Act deals with healthcare waste in Korea. The Act describes the types of healthcare wastes, the generators and standards for the proper disposal. The detailed information on the regulations is provided by MoE as the guidelines.

INTERNATIONAL AND NATIONAL INITIATIVES

Waste Resources Management Division of MoE is the leading unit to carry out the required national survey and projects with a view to providing the data for healthcare waste management in Korea. The Resource Recirculation Center of National Institute of Environmental Research is supporting MoE by doing the required research on healthcare waste. In private sector, three healthcare waste-related associations are under operation to keep the members of the association updated on the regulation and policies developments.

Alarming increases in resource consumption and waste generation are evident across the world and warrant the move towards a sound material cycle society. Reduce, Reuse, and Recycle; the 3Rs of waste management are the buzzwords of the present day world in tackling the resource and waste crisis.

The 3R Knowledge Hub, shortly 3RKH, is a joint initiative of the Asian Development Bank, the United Nations Economic and Social Commission for Asia and the Pacific, the UNEP Regional Resource Centre for Asia and the Pacific and the Asian Institute of Technology. The foremost function of 3RKH is to create, collect and capture 3R information and store it in an easily retrievable platform, in addition to sharing, enriching and disseminating it. The hub functions are hosted and operated jointly by UNEP Regional Resource Centre for Asia and the Pacific and the Asian Institute of Technology, in collaboration with other partners.

With the view of disseminating the information and taking it to a wider audience, the 3RKH maintains a database having extensive collections of 3R materials such as:

- Assessment Reports
- Best Practices
- Case studies
- Conference Proceedings
- Corporate Initiatives
- Journals
- Lessons Learnt
- Manuals / Guidelines
- Periodicals
- Policy Briefs
- Publications

The database also contains a section on 3R policies in Asian countries and a collection of 3R experts and researchers. To access 3R related information, please visit

www.3rkh.net

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